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GÄUMANN (E.). **Ueber das Septobasidium bogoriense Pat.** [*Septobasidium bogoriense* Pat.]—*Ann. Mycol.*, xx, 3-4, pp. 160-173, 1 pl., 22 figs., 1922.

Septobasidium bogoriense occurs throughout Java and has been observed on *Coffea*, *Erythrina*, *Paritium*, *Stachytarpheta*, *Morus*, *Calosanthes*, *Fraxinus*, *Cinchona*, *Thea*, *Solanum*, *Citrus*, *Marsdenia*, *Polyosma*, and *Manihot*. It has also been found in Celebes on *Erythrina* and *Citrus*. The fungus surrounds the entire circumference of twigs and branches, extending in the direction of the longitudinal axis. On the trunks of trees it forms more or less circular or disc-shaped crusts, measuring up to 10 cm. in diameter. Occasionally it extends to the under side of the leaves.

S. bogoriense causes little direct damage to its hosts, its hyphae being incapable of penetrating into sound tissues. Even wounded tissues are invaded only to the depth of a few cell-layers. Indirectly, however, it can cause considerable injury by predisposing to the attacks of other parasites. Thus *Cephaleuros virescens*, which produces cankers on tea plants, finds optimum conditions for development in the humid atmosphere beneath its fungous mantle, while *Corticium salmonicolor* and other parasites can invade the tissues at places in the bark where *S. bogoriense* formerly occurred.

Three zones may be distinguished in the crusts formed by the fungus, especially on *Erythrina* and *Morus*: an outermost, 2 or 3 mm. in depth, thin, transparent, and pure white in colour, where horizontal growth takes place; an intermediate, only about 1 mm. deep, grey-brown or dingy purple, in which vertical development occurs; and an innermost, grey or yellowish-white on the surface, brown internally, which represents the original growth on the surface of the bark. In the early stages, the hyaline hyphae form a closely woven, more or less flat tissue, covering the bark. Large, shapeless haustoria penetrate the epidermal cells, causing no apparent morphological alterations and acting as the sole connecting link between the fungus and its host. The formation of narrow hyphal columns from the surface mycelium then begins, the columns rapidly

increasing in thickness and, after they have reached a certain height, expanding at the top to form a head resembling that of a flat-topped coniferous tree, each expanded top uniting with others in the vicinity. Thus a roof is formed resting on hundreds of slender columns up to 600 μ in height and with arches between. The roof is thin at first, but later the hyphae become densely interwoven and anastomose freely to form a thick, continuous crust, the upper layers of which are composed of hyaline, the lower of brown hyphae.

The formation of these thick hyphal coverings greatly hinders the control of the fungus, repeated sprayings with Bordeaux or painting with 50 per cent. carbolineum having only a slight effect. It is impracticable in large plantations to scrape off the covering, but this appears to be the only means of removing it.

The normal structure of the fungus as described above may occasionally be disturbed by the filling up of the intercolumnar spaces with hyphae, or by a growth on the surface of the outermost crust, in response to external stimuli such as particles of soil or detritus resting thereon, of fresh layers of hyphae which grow round and enclose the foreign particles. The latter process appears to be frequent on *Solanum*.

The organs of fructification are formed in the upper, hyaline portion of the outer crust. Small lateral protuberances on the hyphae develop into 'teleutospores' [probasidia] 6 to 9 μ in diameter, which are generally irregularly distributed throughout the mycelium except in the form on *Citrus*, where they lie in clusters.

The wall of the 'teleutospores' is hyaline and somewhat thicker than that of the hyphae. Nuclear union, as in *Jola*, probably takes place in the basidia, but could not actually be detected on account of the minute size of the nuclei. Clamp-connexions are present in the mycelium.

Germination takes place after a very brief interval, by the protrusion of a rather thick, four-celled basidium, which may be short and remaining immersed in the mycelium (*Citrus*), or long and emerging on the surface of the crust (*Erythrina*). This bears, on comparatively long sterigmata, long, narrow basidiospores, 9 to 16 by 2 to 3 μ, closely resembling those of *Jola javensis*.

The fungus was successfully cross-inoculated on a number of hosts, several of which (*Solanum*, *Stachytarpheta*, and *Marsdenia*) are not indigenous to Java.

The author does not accept Raciborski's identification of this fungus with *Helicobasidium mompa* Tanaka.

SNELL (W. H.). **Studies of certain fungi of economic importance in the decay of building timbers, with special reference to the factors which favour their development and dissemination.**—*United States Dept. Agric. Bull.* 1053, 41 pp., 8 pl., 3 figs., 1922.

All the five species of wood-decaying fungi studied by the author, viz. *Lenzites saepiaria*, *L. trabea*, *Trametes serialis*, *Fomes roseus*, and *Lentinus lepideus* have been found fruiting more or less commonly on timber used in mill roofs or in basements. The damage done by the first two to coniferous roof timbers is more considerable

than has been reported hitherto. The annual form of *Fomes carneus*, considered by some mycologists as a distinct species, *Trametes carnea*, is of common occurrence on beams in moist basements, but it is not certain whether the perennial form also occurs. It is pointed out that the high temperature and humidity of textile and paper mills, canning factories, and the like are very favourable to the development of wood-rotting fungi. The increased use in recent years of inferior wood has accentuated the trouble. Numerous instances are given of heavy losses from this cause.

The basidiospores of all the fungi mentioned germinated readily on various agars, on red spruce wood, and in tap water, and irregularly in distilled water. Investigating the effect of temperature on the viability of the spores, the author accepted the percentage of spore germination as the best criterion of the influence of environmental conditions in the spread of infection. At 40° C. the basidiospores of *Lenzites saepiaria* gave a high percentage of germination, while those of *L. trabea* and *Fomes roseus* gave small percentages, and the germination of the spores of the other two species was totally inhibited. The optimum temperatures for rapidity of germination were: *Lenzites saepiaria* 32° to 35° C., *L. trabea* 28° to 32° C., *Trametes serialis* 30° to 32° C., *Fomes roseus* 28° to 32° C., *Lentinus lepideus* 28° C. Given sufficient time, large percentages of the spores germinated at the lower temperatures within the range of growth for each species. Diffused light was found to have no effect on the germination of the spores. An exposure of one day to direct sunlight in May and June did not affect the viability of the spores materially. An exposure of two days usually reduced the percentage of germination considerably, sometimes entirely, while three days' exposure usually killed most of the spores. The germ-tubes showed no phototropic response. In drying tests, basidiospores of *Trametes serialis* and *Lentinus lepideus* (aged 10 days and 7 months respectively) were killed by about ten weeks' exposure at 28° and 32° C., and by about a month at 36° C. At 40° C. fresh spores of *Lenzites saepiaria* survived for two months, and of *Trametes serialis* six weeks in an unfinished test. Five months old spores of *Fomes roseus* were killed in one week at the same temperature. A number of tests made upon different lots of varying ages seemed to show that alternate wetting, either with free water or by atmospheric moisture, and subsequent drying, reduced the viability of the spores. Basidiospores of *Lenzites saepiaria* gave a germination of 25 per cent. after 2 years and 10 months' storage in an ice box, those of *L. trabea* 50 per cent. after 1 year, of *Trametes serialis* 2 per cent. after 4 years and 3 months, of *Fomes roseus* less than 1 per cent. after 18 months, and of *Lentinus lepideus* less than 1 per cent. after 2 years and 7 months.

With the exception of *Fomes roseus*, all the species under consideration have been shown to be able to liberate large numbers of basidiospores within buildings. In a series of experiments to test the ability of sporophores to survive successive wetting, spore-liberation, and drying, *Lenzites saepiaria* shed spores six different times, but on the seventh attempt no visible spore-print could be obtained. A fruit body of *Trametes serialis* kept in a dark fungus

pit shed spores for fifteen days successively. Observations upon sporophores of this fungus in the bottom of a closed pit showed that slight convection currents of air carried spores upward and throughout the pit. In factories, air currents caused by machinery, humidifiers, and heating pipes play an important part in the dissemination of spores cast into the air. Other observations suggested the possibility of insects and other animals also being implicated in the spread of infection.

A description of the macroscopic and microscopic characters of malt agar cultures of the fungi with a key for identification by mycelial characters is given. The cardinal temperatures for mycelial growth were found to be as follows:

	Minimum.	*Optimum.*	*Maximum.*
Lenzites saepiaria .	About 8° C.	30°–34° C.	Above 40° C.
Lenzites trabea . .		28°–30° C.	Little above 36° C.
Trametes serialis .	About 3° C.	28° C.	Between 32° and 37° C.
Fomes roseus. . .	Below 4° C.	30° C.	Above 36° C.
Lentinus lepideus .	About 8° C.	28° C.	Between 36° and 40° C.

Considerable attention was paid to the characters of the secondary spores formed by these fungi in view of their possible occurrence in nature under mill conditions. Oidia and chlamydospores were found in agar cultures of *Lenzites saepiaria* and oidia in wood cultures; both kinds occurred in agar cultures of *L. trabea*; while only chlamydospores were formed in agar cultures of *Trametes serialis* and *Lentinus lepideus*. Certain of the physiological relations of the oidia of *Lenzites saepiaria* and *L. trabea* and the chlamydospores of *Trametes serialis* were studied. The germination temperatures corresponded closely with those of the basidiospores of the respective species, except that the oidia germinated better at the higher temperature tried. Diffused light had no effect on the germination, but the latter was prevented by ten hours' exposure to sunlight in May. Both oidia and chlamydospores were usually rapidly killed by drying and by alternate wetting and drying. Only a few survived drying at room temperature for some months. The oidia of *Lenzites saepiaria* and *L. trabea* were found not to be adapted for dissemination by air currents, but they could be disseminated by insects (e.g. cockroaches) and water. This character may possibly be of some importance in case oidia are found to be produced naturally in mills. Thus far, however, the only secondary spores of these fungi found in factories are the chlamydospores of *Lentinus lepideus* that are borne on the fruit bodies.

BEWLEY (W. F.). **'Sleepy disease' of the Tomato.**—*Ann. Appl. Biol.* ix, 2, pp 116–134. 4 pl., 1922.

'Sleepy disease' of tomatoes, which occurs in all parts of the British Isles and has been attributed to *Fusarium lycopersici* Sacc. since Massee's description of it in 1896, is shown by the author to be caused usually by *Verticillium albo-atrum*, though it can also be produced by the former fungus. Massee evidently observed

both forms but considered that they were merely different stages (the *Diplocladium* stage and *Fusarium* stage respectively) of *F. lycopersici*.

Plants attacked by *Verticillium* are usually stunted, the younger internodes being badly developed. The leaves wither from the base of the plant upwards, adventitious roots develop on the stem, and ultimately the plant dies. The symptoms appear first about the middle of April and increase in intensity for a month or more, gradually subsiding to recur with renewed force at the end of September. The attacks of *F. lycopersici* occur during the hottest part of the season, in July and August in the Lea Valley, where these observations were chiefly made on plants grown under glass. It does comparatively little damage in the British Isles. Of 427 affected plants from different localities examined in 1919–20, 307 yielded *Verticillium* alone, 77 *Verticillium* and either *Fusarium ferruginosum* or *F. sclerotioides*, 26 *Verticillium* and *F. oxysporum*, and 17 *F. lycopersici* alone.

Inoculations showed that infection by *Verticillium* can occur through the stem or root but that, under the conditions of the experiments, the period from June to September was unfavourable for the development of the fungus. Inoculations through the soil were also successful and sterile seedlings grown on agar were readily attacked, the experiments indicating that penetration can occur through the unbroken epidermis. Plants with hard, thin stems, or obviously starved, succumbed most readily to attack.

Inoculations were also carried out with the four species of *Fusarium* mentioned above as having been isolated from wilted plants. *F. ferruginosum* and *F. sclerotioides* failed to produce wilt under any conditions and must be regarded as saprophytes. F. *oxysporum* caused a rot of the pith and cortex around the point of inoculation and in some cases killed root tissues. It produced a slight desiccation of the lower leaves at temperatures of 27·8° to 28·9° C., but wilt did not as a rule result from inoculation with this species. Typical symptoms of wilt were produced by *F. lycopersici* at temperatures of 28° to 29° C. but below 28° infection was uncertain.

The walls of the vessels of plants affected with sleepy disease are turned brown, and a brown, gummy substance frequently occupies the lumen. As the culture liquids in which *Verticillium* was grown were found to contain a substance capable of causing wilt when filtered free from the fungus, an attempt was made to isolate the enzymes produced during growth. No evidence was obtained that endo-enzymes capable of causing wilt were present in the mycelium, but *Verticillium* is stated to form a definite exo-enzyme which is capable of discolouring the vessels and producing wilt in seedlings when the latter are severed from their roots and placed in turnip juice filtered from germinated spores. A brown, gummy deposit was found in the wood in these cases, and the cambium was destroyed near the end of the stem. The enzyme was precipitated by absolute alcohol and found to be greatly reduced in activity by heating to 100° C. for five minutes. The fungus was found to produce amylase, inulase, emulsin, lipase, protease, erepsin, and amidase.

Considerable differences were found in the virulence of different strains of *Verticillium* studied in single spore isolations, as judged by the period required to produce complete wilt. Indications were obtained that high virulence is correlated with ability to form carbonized hyphae and microsclerotia. Amongst the hosts other than tomato that were successfully inoculated were potato, egg-plant, cucumber, and *Antirrhinum* (snapdragon). In cotton and sycamore (*Acer*) the plants were stunted and the leaves withered without wilting, while *Capsicum* sp. was stunted but the leaves remained green and only a few wilted, and in *Ulmus* nothing but slight stunting occurred.

Wilt due to *Verticillium* develops most rapidly in glasshouses kept at temperatures between 15·6° and 24° C., the optimum being 21·1° to 22·8°. It is greatly delayed at 12·5° and practically inhibited at 25° C. The minimum, optimum, and maximum temperatures for the fungus, grown in pure culture, are 4·4°, 23·3°, and 30° C. *Verticillium* wilt is a typical moderate temperature disease, which explains its greater severity in the spring and autumn. Suitable shading of the houses diminishes the intensity of the attack, the plant probably being assisted by reduced transpiration. There is no necessary relation between the disease and any special type of soil, but plants grown in cool, clay soils are more liable to attack than those in sand, and a high humus-content also appears to predispose to the disease.

Cultural methods of control have given promising results in the Lea Valley. In badly infested localities resistant varieties such as Manx Marvel or Bide's Recruit should be grown. Attempts to raise other wilt-resistant strains are being carried on by the author. Slightly soft rather than hard growth should be encouraged. On the first appearance of wilt the average day and night temperature should be raised to over 25° C. A light coating of whitewash on the glass is advisable. Watering the roots aggravates the wilting, but a light overhead sprinkling is beneficial. The base of the plants should be mulched to promote the development of new roots. In one nursery the percentage of wilted plants was reduced in a fortnight from 78 to 10 by these means. When the soil of the beds is sterilized, great care is required to avoid the reintroduction of the fungus as it develops very rapidly in sterile soil, especially if rich in humus.

The spores that develop on external mycelium at the base of the dead plants germinate and give rise to carbonized hyphae and microsclerotia capable of overwintering. All dead plants and débris should, therefore, be carefully removed as soon as the crop is picked. The baskets in which the seedlings are carried, contaminate water, and the importation of young plants from infected nurseries are all common sources of new infections. The vicinity of the nurseries should be kept free from weeds (suspected to include hosts of *Verticillium*), potatoes, *Antirrhinum*, &c. In a note at the end the author records the occurrence of a sweet-pea wilt which was found to be due to *V. albo-atrum*, and successful cross-inoculations between tomatoes, cucumbers, and sweet-peas were obtained.

WHITEHEAD (T.). **Varieties of Swedes resistant to finger-and-toe.**– *Journ. Min. Agric.*, xxix, 4, pp. 362–368, 1922.

Trials carried out in 1921 with four British varieties of swedes, together with two Danish resistant strains (varieties 4 and 25), on three farms in Carnarvonshire, indicate that the Danish varieties resist club-root or finger-and-toe [*Plasmodiophora brassicae*] to a more marked degree, and in addition keep better and have a higher feeding value than the British ones. The Danish variety 25 was more resistant under North Wales conditions than the Danish variety 4, which is the reverse of the results obtained in trials in Denmark reported by Christensen [*Tidskrift for Planteavl*, xxvi, 1, p. 68, 1917].

SCHAFFNIT (E.). **Versuch über die Empfänglichkeit verschiedener Kohlsorten für den Erreger der Kohlhernie.** [Experiments on the susceptibility of various Cabbage varieties to the organism causing club-root.]—*Deutsche Obstbauzeit.*, lxviii, 21-22, pp. 211–212, 1922.

Experiments were carried out at Bonn in 1921 to test the susceptibility to *Plasmodiophora brassicae* of ten varieties of white cabbage, three of red cabbage, one of Savoy, one of kale, two of Brussels sprouts, and two of kohlrabi. With the exception of the last-named, all the plants showed a very high degree of susceptibility to the disease, 100 per cent. of infection being observed in many cases. The kohlrabi was harvested in July, while the remaining varieties were left until August, and this may possibly explain its relative immunity.

LEHMAN (S. G.). **Pod and stem blight of the Soy-bean.**—*Journ. Elisha Mitchell Sci. Soc.*, xxxviii, 1-2, p. 13, 1922.

The fungus *Phomopsis sojae* causes serious damage to the soy-bean in North Carolina, especially in wet seasons. Pods, stems, and occasionally leaves, are attacked, the heaviest losses resulting from attacks on the pods. Very young pods drop off when attacked, while older ones remain firmly attached. The fungus penetrates the pod wall and invades the developing seed. The ovule may abort at an early stage or the seed may become more or less shrivelled according to the time and severity of infection. Seeds in diseased pods are often completely invested with a conspicuous, white, fungous covering. The minute, black pycnidia scattered over the diseased areas begin to exude small, hyaline, single-celled spores within a few days after their appearance.

The fungus has been isolated from stems, pods, and seed, and has been observed to cause the death of seedling soy-bean plants by growing from the seed coat on to the hypocotyl and causing its decay. It overwinters in diseased stems and seed. The ploughing under of diseased plants after harvest, use of healthy seed, and crop rotation are recommended.

MILBRATH (D. G.). **Control of diseases of Cucumbers in greenhouses.**—*Monthly Bull. Dept. Agric. California*, xi, 5–6, pp. 430–437, 4 figs., 1922.

During the last two years the cucumber-growing industry has

made rapid progress in California, and a brief description of the more important diseases and the means of controlling them is given in this paper for the assistance of growers.

Mosaic disease is said to be controlled to some extent by destroying affected seedlings. The method recommended is to sever the main stem at the ground level and allow the vine to remain for 36 to 48 hours before further touching it. By this time the virus in the severed vine will have lost much of its strength, and the seedling may be removed with less danger of contaminating the healthy plants. Protection against the insect carriers of this disease may be effected by fumigation with hydrocyanic acid gas, but care must be taken not to use the latter when any form of copper sulphate treatment has been given. The wild cucumber (*Micrampelis lobata*) and the one-seeded bur cucumber (*Sicyos angulatus*) are both hosts of mosaic and must not be allowed to grow in the vicinity of the cultivated kinds.

Sclerotinia rot, which is stated to be most frequently introduced with organic manure and disseminated by insects, may be controlled by severing the infected laterals from the main stem and washing the resultant wound in a 1 in 1,000 solution of corrosive sublimate. *Fusarium* fruit rot may be suppressed by similar measures. Angular leaf-spot, caused by *Bacterium lacrymans*, is said to be frequently transmitted by pickers from diseased to healthy plants, and also by insects, but the most important source of dissemination is the water used for spraying the foliage. The disease is believed to be carried on the seed, and treatment with a 1 in 1,000 solution of corrosive sublimate is recommended. Powdery mildew (*Erysiphe cichoraceaarum*) is stated to be adequately controlled by spraying the plants with a 1 in 40 solution of lime-sulphur.

The regulation of temperature and humidity is regarded as being extremely important. The optimum temperature for the plants ranges from 60° to 75° F. High humidity favours the development of mildew, *Sclerotinia*, and *Fusarium* rot, and thorough ventilation is essential, even if the open windows necessitate a greater expenditure of fuel. Thin-leaved varieties are liable to sun-scald, followed, in severe cases, by attacks of *Alternaria* and *Cladosporium*. Washing the plants with a fine mist of water on sunny days is recommended as a preventive of this trouble.

Osborn (T. G. B.) & Samuel (G.). **Notes on two Vine diseases which occurred on the River Murray in October, 1921.**—*Journ. Dept. Agric. South Australia*, xxvi, 3, pp. 225–230, 5 figs., 1922.

During the latter part of October, 1921, vine shoots showing a die-back of the tips were submitted for examination to the Laboratory of Plant Pathology at the University of Adelaide. Two diseases were found to be involved, one of fungous and the other of physiological origin.

The former, due to *Aureobasidium vitis*, caused the blackening and death of the tips of the shoots and a decay of patches of irregular shape on the leaves. Kept overnight in a moist chamber, the leaves turned black all over and the surface became rather sticky, minute, whitish dots simultaneously appearing on the affected parts.

Specimens sent in a few weeks later showed the fungus attacking the young fruit bunches. Sections through the whitish pustules revealed small heaps of spores, budded off from the fertile ends of hyphae arising from the mycelium growing through the tissues of the leaf.

A. vitis was discovered in France in 1882, its occasional attacks usually occurring in muggy weather and causing only slight losses. The species has been sub-divided into several varieties, the South Australian specimens agreeing most closely with Montemartini's var. *album*, both in the parts affected and in the nature of the spore pustules.

The majority of the affected vines were young, one and two year old plants, and there was a cover-crop of wheat growing between the rows. Possibly the presence of wheat helped to maintain the humidity necessary for infection. The hot weather at the end of October arrested the spread of the disease and the dead patches on the leaves dried out. Where the shoot tip had been killed, numbers of laterals sprang from below, making it difficult to secure good canes to form the vines. Death occurred only in the case of one or two vines which had very small shoots at the time of infection. Cases of the disease occurred in several districts, the weather conditions evidently being such as to induce a mild epidemic of what is ordinarily a parasite of little importance.

The second disease, believed to be of physiological origin, occurred in various localities along the Murray valley. Blackening and death of the tips of the young shoots was occasionally noted, but a more characteristic feature was a mottling due to the development of small angular areas of a pale green or brown colour in the leaves, producing a mosaic effect. Only three to five leaves on a shoot were thus affected, those above and below being quite healthy. The spots were usually more numerous near the veins. The fresh healthy growth shown by many vines inspected some three weeks after the first report of the disease indicated that the causal agency had operated everywhere at about the same time and then been completely removed. The development of the main shoot was often considerably impeded, and it was sometimes outgrown by strong laterals springing from the base.

All attempts to detect or isolate a fungous or bacterial parasite failed. The pathological changes in the cells of the discoloured areas—gummosis of the cell walls, rupture of some cells and the secretion of oily substances in others—agree in the main with those that follow injury by late frosts. The affected vineyards were all situated on low-lying areas where the temperature probably fell to freezing point about the time the injury occurred, while active root absorption was maintained owing to the comparative warmth of the soil. Possibly these conditions led to the pathological changes noted above.

BROWN (J. G.). **Plant pathology.** *Thirty-second Ann. Rept. Arizona Agric. Exper. Stat. for the year ended 30th June, 1921*, pp. 606–615, 4 figs., 1922.

The fungous diseases of the principal crops recorded in Arizona

during the year are enumerated and those of special interest briefly described.

A serious rot of dates [*Phœnix dactylifera*], which is likely to cause trouble to Arizona date growers, is reported. It sometimes causes the loss of 95 per cent. of the crop. The disease is characterized by the appearance on the fruit either of minute, chocolate-brown spots which eventually coalesce and cover one side, becoming creamy-white in the centre, or of small, water-soaked areas which finally unite to form a blister. In both cases the protective layers of the fruit are ruptured, resulting in drying and mummification. The mummified fruit may remain hanging to the clusters or may drop. Both kinds of spots occur on the leaflets, and the brown spots are also found on the petioles and on the stalks and branches of flower and fruit clusters. Blistering does not take place on the more woody organs.

Isolations from diseased leaves and fruits gave several organisms. Of these, species of *Macrosporium*, *Alternaria*, and *Helminthosporium* were shown by inoculations to be actively parasitic on the unripe fruit. These fungi probably rupture the protective outer layers of the fruit and leaves, thereby facilitating the admission of secondary organisms. The hyphae pass through and between the cells, which are killed rapidly. The tannin layer of the fruit temporarily checks penetration towards the centre, but the hyphae spread parallel with the surface, killing the outer parenchymatous tissue and leaving a cavity under the cuticle and epidermis which becomes filled with air and produces the blistered appearance described above. After the formation of a blister, the surface soon cracks enough to cause the mesocarp to dry out, and the hyphae finally succeed in penetrating the tannin layer and thus reach the endocarp.

The very valuable Deglet Noor variety is probably the most susceptible to this date rot, but none is entirely immune. Fruit clusters sprayed in 1921 with Bordeaux mixture 4–4–40 were free from the disease at the time of writing.

Black arm and angular leaf spot (*Bacterium malvacearum*) were present in nearly every field of Pima-Egyptian cotton, the injuries to the crop including stem lesions, destruction of leaf tissue, boll spotting, premature ripening, and fibre staining. Some fields were practically ruined. The appearance of the attack supported the view that the causal organism is carried by the seed. Arizona cotton growers are unfortunately slow to adopt the method of seed treatment [see this *Review*, i, p. 383] which has effectively controlled this disease in the south. Experiments are in progress to ascertain whether the large quantities of alkali in the cotton districts of Arizona increase the susceptibility of the crop to *Bact. malvacearum*. Other cotton diseases recorded were sore shin caused by *Rhizoctonia* [*solani*], wilt (*Fusarium vasinfectum*), and root rot (*Ozonium omnivorum*).

A severe outbreak of bacterial rot of lettuce occurred in two localities in the spring of 1921. The outer leaves of the head were generally affected first, a brown discoloration of the veins and then of the entire leaves ensuing, until the head was finally transformed into a dark, slimy mass. One whole field of sixty acres was ruined.

Laboratory studies revealed the presence of two bacteria capable of completely rotting healthy heads of lettuce within two or three weeks. The identity of the bacteria has not yet been established. In the eastern states bacterial rot of lettuce has been attributed to the use of poorly rotted manure, but in Arizona no fertilizers have been used in the silt fields concerned. *Ozonium omnivorum* also attacked this crop.

Grapes were affected by a new type of rot, the cause of which is obscure. In this disease unripe fruits of white varieties are spotted with soft, brownish, semi-translucent areas, which become bronzed as shrivelling and rotting proceed, and later turn purple. Drying progresses more rapidly on one side than the other, and the tissues collapse so that the outline of the seeds can be distinguished. Often the berry remains normally green except for one sunken spot. Cultures from surface-sterilized fruit generally gave no growth, except an occasional *Gloeosporium* with much larger spores than those of any species hitherto reported on the grape.

There are numerous other records, mostly of common or well-known diseases of crops and ornamental plants.

Annual Report, Department of Agriculture, Uganda, for the year ended 31st December, 1921. 87 pp., 1922.

In addition to the Report of the Government Mycologist, which is separately noticed [see next abstract], there are various references to plant diseases of interest.

In the Report on the Government Plantation, Kampala, J. D. Snowden states that coffee leaf disease (*Hemileia vastatrix*) was extremely prevalent and exceptionally virulent on *Coffea arabica* from June to August, a large number of the trees being entirely defoliated for a time. Some varieties of *C. robusta* were also considerably damaged by the disease. The most resistant of the *robusta* types are Toro, Quilou, and three trees of *C. congensis* var. *chalottii*. All the three varieties of *C. excelsa* that were grown remained very resistant to leaf disease. *C. liberica* is also highly resistant, but is less vigorous, and gives a lower yield than *C. excelsa*.

Hevea rubber trees were attacked throughout the year by a species of *Oidium* which caused a serious loss of young foliage. 'Black thread' [*Phytophthora* sp.] was less serious than in the previous year, the percentage of affected trees being 18·33 as against 48·25. Most of the infections again occurred in series which were being tapped near the base. Painting the infected parts with undiluted ordinary Brunolinum and the disinfection of the tapping cuts with 2 per cent. Izal gave good results.

There were twenty-eight existing cases of brown bast disease of *Hevea* in May and ten new infections were found to have occurred by the following November. The important fact was noted that only 2·89 per cent. of the trees tapped on alternate days were infected, as against 18 per cent. of those tapped daily. 'Stripping' for the cure of the disease must be carried out at an early stage, as otherwise the surface of the cambium becomes badly damaged by the formation of nodules. The operation should be performed when the foliage is just mature. Trees which are 'wintering' or are full

of young foliage cannot be stripped without difficulty and risk of injury.

G. T. Philpott reports that trees of *Coffea arabica* at the Government Plantation, Kakumiro, Mubendi, were remarkably free from *Hemileia vastatrix* until a severe outbreak occurred in the middle of November. Costa Rica and Bourbon coffee trees, planted in 1918, were severely attacked by root scale (*Pseudococcus citri*), accompanied by white root disease [*Polyporus coffeae*], and efforts to control the combined attack have not been very successful so far. White root disease is constantly recurring, and the use of lime or some other soil sterilizer will probably be necessary to ensure profitable coffee-growing on the Kakumiro Plantation.

SMALL (W.). **Annual Report of the Government Mycologist for 1921.**—*Ann. Rept. Dept. Agric. Uganda, 1921*, pp. 49–57, 1922.

The two best-known fungi on coffee in Uganda are *Hemeleia vastatrix* and *Colletotrichum coffeanum* [*Glomerella cingulata*], but the author points out that they are not the greatest enemies of the crop. The former is not, under Uganda conditions, so harmful or progressively weakening as had been expected, and spraying against leaf disease is never attempted nowadays. Good cultural methods can to a great extent neutralize the injurious effects of attack by this rust. *Colletotrichum* is not an aggressive parasite, but merely a common saprophyte that can attack weakened bushes. The true cause of die-back, when it occurs on a large scale, is lack of vigour due to unfavourable conditions such as over-bearing, absence of shade, weeds, and bad cultivation generally. Occasional direct attacks of *Colletotrichum* do occur, but are usually on a small scale, and affect only a few branches or young twigs. The author recommends that the term anthracnose, and not die-back, should be used for the latter form of the disease.

The brown-eye spot (*Cercospora coffeicola*) of coffee leaves and berries was more prevalent than in previous years, over 60 per cent. of the berries being affected in some cases. The only root disease of coffee reported was the white root disease caused by *Polyporus coffeae*, which has never been found as an independent parasite, but at times accompanies the coffee root mealy bug, *Pseudococcus citri*.

Of considerable interest is the record of the appearance of the powdery mildew (*Oidium* sp.) of *Hevea brasiliensis* in two localities in Uganda. This disease, previously known only in the Dutch East Indies, does not appear to be serious, causing only the death of a few twigs and the deformation and loss of a few leaves. The attack was typical of the published descriptions from Java. No case of root disease of *Hevea* was reported, though both *Ustulina zonata* and *Fomes lignosus* are known on other hosts in the colony.

Associated with orange rust of wheat (*Puccinia triticina*) is the leaf spot fungus *Leptosphaeria tritici*, while a *Helminthosporium*, provisionally named *H. sorokinianum*, is common. One case of supposed downy mildew of maize [*Sclerospora* sp.] was encountered. The leaf symptoms appeared unmistakable, though the causal fungus itself was not found. No smuts have been found on this crop in Uganda. Sorghum is attacked by head smut (*Ustilago reiliana*) and grain smut (*Sphacelotheca sorghi*), the latter being the more common.

Another disease of sorghum, downy mildew or green ear, was discovered in July, 1921, at Bukalasa. The symptoms consist of a whitening in streaks of the young leaves, followed by browning, twisting, and crinkling. The oospores of the parasite [*Sclerospora* sp.] were found in the tissues of affected leaves, but they were only half the size of the oospores of the fungus [*Sclerospora graminicola*] which induces the similar disease in India.

Several diseases of shade, fruit, and ornamental trees and plants are mentioned. Roses, *Grevillea robusta*, *Melaleuca leucodendron*, and *Spondias lutea* are added to the list of hosts of the wet root rot fungus. Further attempts to induce the latter to fruit in culture gave negative results. *Albizzia moluccana*, grown as coffee shade, succumbed to attacks of *Botryodiplodia theobromae* on the roots. The attack probably begins on very small roots while the trees are quite young; the fungus makes very gradual progress, and death occurs just when the trees are beginning to be of use for shade purposes. *B. theobromae* also causes a die-back of pruned branches of the same host, and it is recommended that the use of the latter as a coffee shade tree should be abandoned. The leaves of fig trees were severely attacked by *Uredo fici* [*Kuehneola fici*], and the fruit by a species of *Colletotrichum*.

A report on an investigation into certain fungi occurring on diseased rice in Uganda is appended. Specimens of diseased rice collected in 1920 were reported by the Imperial Bureau of Mycology to bear the following fungi: *Piricularia oryzae*, *Helminthosporium oryzae*, *Leptosphaeria michotii*, *Gibberella saubinetii*, *Graphium stilboideum*, and *Fusarium roseum*. The following further fungi have been noted on rice material: *Phoma glumarum*, *Epicoccum hyalopes*, and *Melanospora zamiae*. Of these fungi *G. saubinetii* had not previously been recorded on rice, and *Piricularia oryzae* was reported for the first time from Africa.

The writer carried out an investigation on the part played by these fungi in the disease in question, and found that the whole of the damage could be attributed to *P. oryzae*. He states that only one major disease of rice is at present known in Uganda, namely, the well-known 'blast' of this crop. Further specimens of *G. saubinetii* were not obtained in any case, and the *Fusarium* commonly present on diseased plants is regarded as not belonging to this fungus. Inoculations with it on young rice, wheat, and maize failed to produce any effect.

An account of the author's studies on another species of *Fusarium*, which causes a wilt of various plants, has been separately published, and is noted elsewhere [see below, p. 163].

WOLF (F. A.). **Studies on fermentation of rare sugars by plant pathogenic bacteria.**—*Journ. Elisha Mitchell Sci. Soc.*, xxxviii, 1-2, pp. 12-13, 1922.

Different species of pathogenic bacteria from the same host may be indistinguishable on the basis of their ability to ferment the carbohydrates of the Descriptive Chart. The fermentation of rare sugars has, therefore, been used as a means of identification of certain closely related organisms. *Bacterium tabacum* and *B. angulatum*, the causal agents of wildfire and angular leaf spot of tobacco

respectively, are both able to form acid from dextrose and saccharose, but not from glycerine and lactose. The former, in addition, attacks manitol and galactose, while the latter does not affect them. A similar specialization obtains in the case of two leaf spot organisms of soy-bean, *Bacterium glycineum* and *B. sojae*.

ROSEN (H. R.). **The bacterial pathogen of Corn stalk rot.**—*Phytopath.*, xii, 10, pp. 497-498, 1922.

Bacterial stalk rot of maize [see this *Review*, i, p. 170], first described from Arkansas, and now reported from about eight different States, is caused by *Pseudomonas dissolvens* n. sp., which is briefly characterized as follows. Short, plump, rapidly growing rods, motile by means of a single polar flagellum, bluntly rounded at both ends, occurring singly, in pairs, or occasionally in short chains, 0·7 to 1·2 by 0·5 to 0·9 μ, capsules present, colonies on nutrient agar poured plates (testing P_H 7·0) round, margins entire, white, opaque, glistening, consistency of melted butter, smelling strongly of decaying vegetable matter. Gelatine and Loeffler's blood serum not liquefied; acid and gas produced on most nutrient media; diastatic action perceptible; indol and ammonia produced; nitrates reduced; coagulation of milk marked on sixth day; growth in Uschinsky's solution good. Index number, according to the most recent chart of the Society of American Bacteriologists (1920), 5322-32220-1111.

STAKMAN (E. C.) & LEVINE (M. N.). **The determination of biologic forms of Puccinia graminis on Triticum spp.**—*Univ. Minnesota Agric. Exper. Stat. Tech. Bull.* 8, 8 pp., 1 fig., 1922.

It has been shown by the present writers and others that *Puccinia graminis tritici* (Pers.) Eriks. & Henn. really consists of several biologic forms recognizable by their action on different varieties of wheat (*Triticum vulgare, T. durum, T. compactum*), emmer (*T. dicoccum*), and einkorn (*T. monococcum*). A method has been developed for the identification of the thirty-seven biologic forms now known, by their parasitic action on a selected group of varieties of *Triticum*. Little Club is susceptible, and Khapli highly resistant, to all the known forms of the rust.

Twelve 'differential hosts' of the groups referred to above are inoculated and incubated for 48 hours, the best results being obtained by keeping the plants under optimum conditions for rust development. Plenty of sunlight is essential. The types of infection are indicated by numerals from 0 to 4, the former being equivalent to practical immunity, and the latter to complete susceptibility. Fluctuations within a class are designated by plus and minus signs. Plants on which the degree of attack, as judged both by the number of sori and their size and other characters, ranges from 0 to 2 are marked immune, very resistant, and moderately resistant respectively, while those infected in the degrees of 3 and 4 are designated moderately susceptible and very susceptible. In addition to these five types, a sixth occurs when certain biologic forms are inoculated on some varieties of wheat. In this type various degrees of infection may occur apparently ranging from 1 to 4, and with all types of sori on the same leaf. Such hetero-

geneous types of infection are placed in a separate group X, and have to be very carefully distinguished from cases of mixed infection by two or more strains of the rust.

An analytical key is given by which each of the thirty-seven biological forms of the fungus can be recognized by its behaviour when inoculated on the differential hosts in a certain definite order.

WEBER (G. F.). **Septoria diseases of Cereals. 1. Speckled blotch of Oats caused by Leptosphaeria.**—*Phytopath.*, xii, 10, pp. 449-470, 2 pl., 5 figs., 1922.

Speckled blotch of oats, caused by *Septoria avenae* Frank, occurred to a limited extent on volunteer oats near Madison, Wisconsin, in September, 1921. Hitherto the disease (which is distinct from that caused by *Septoria gramineum* var. *C. avenae* Desm.) was only known in England and Germany. The *Septoria* lesions were rather small, circular to elongate, elliptic, killed and faded areas, 2 to 4 by 2 to 8 mm. in size, and distinguished by the black, more or less scattered pycnidia.

The fungus was isolated and single spore cultures on oatmeal agar and potato agar yielded perithecia with mature asci in 1922, as well as pycnidia. Single ascospores were transferred to culture tubes, and gave rise to pycnidia and later perithecia. Inoculations of oat seedlings with ascospores also gave typical *Septoria* spots. From this it is clear that the ascigerous stage of *Septoria avenae* has been found. It is a new species belonging to the genus *Leptosphaeria*, and the author names it *L. avenaria*, adding a full description.

The pathogenicity of the organism was completely proved by re-isolating it from artificially infected spots. The results of inoculation experiments showed that whilst no infection occurred on hosts other than *Avena*, the following species besides *A. sativa* were susceptible: *A. barbata*, *A. brevis*, *A. fatua*, *A. nuda*, and *A. strigosa*.

Detailed cultural and germination studies are described; cultures of germinating ascospores in dilute Indian ink revealed the presence of a gelatinous sheath round the spore and the older portions of the germ-tubes, which sheath may play an important rôle in infection. The cardinal temperatures for mycelial growth on agar poured plates are as follows: minimum 2° C., optimum 20° to 25° C., and maximum 32° C. The fungus grows best on a slightly acid medium; development was retarded at H-ion concentrations lower than P_H 3·8 and higher than P_H 7·0.

The method of infection was studied, and it was found that both pycnospores and ascospores lodge in the furrows between the epidermal cells and there develop germ-tubes, the tips of which apply themselves to the cuticle directly above adjoining walls of the epidermal cells. The infecting hyphae penetrate the cuticle, and grow down between the epidermal cells, after which they develop intercellularly, no haustoria being found. Pycnidia form below the stomata where the hyphae collect and become matted together.

The incubation period is from twelve to sixteen days, the first symptoms of infection (light-coloured spots on the leaves) being noticeable on the eighth or ninth day. The pycnospores remain

viable over winter when retained in the pycnidia. On 1st April, 1922, 90 per cent. of the spores from diseased oat leaves collected in the previous September germinated.

DUC (L.). **L'ergot du Blé dans l'Ain.** [Ergot of Wheat in the Ain Department.]—*Journ. Agric. Prat.*, lxxxvi, 43, pp. 360–361, 1922.

In July 1922 the writer observed a 4-hectare field of wheat in the Ain Department in which there was a severe attack of ergot [*Claviceps purpurea*], confined to one variety (Carré Vaudois) of the five varieties cultivated in the field.

Clean seed was stated to have been used, but it was not treated with any fungicide before sowing. The presence of ergot could not be detected on grasses in the neighbourhood, nor did it occur on another field of Carré Vaudois a few miles distant. Reports of ergot on barley have been received from two localities in the same district.

The length of the sclerotia at harvest varied between 1 and 2 cm., the maximum weight was 155 mg., and the average weight of 10 was 22 gm. About one ear in every ten was infected.

SCHAFFNIT (E.). **Zur Bekämpfung der Pilzkrankheiten des Getreidekorns.** [On the control of fungous diseases of cereals.]—*Mitt. aus dem Inst. für Pflanzenkrankheiten der Landwirtschaftl. Hochschule Bonn-Poppelsdorf*, in *Landw. Jahrb.*, lvii, 2, pp. 259–283, 1922.

In this paper the author discusses a large series of trials of fungicides for the disinfection of seed grain, including several recently introduced proprietary preparations, and also considers the influence of certain external factors on the incidence of cereal diseases.

Copper sulphate and formaldehyde, until recent years the two principal disinfectants of seed grain, are open to the serious objection of reducing or retarding germination. This defect becomes marked not only when the prescribed strength of the solution or duration of immersion is exceeded, but also when atmospheric conditions or the factors influencing physiological activity are unfavourable, and, generally, in the case of exotic or delicate varieties. Formaldehyde injury was considerable in experiments during the autumn and winter of 1920–21, when the low temperature combined with scanty rainfall set up unfavourable conditions. In a plot of winter wheat treated by immersion in 0·2 per cent. formaldehyde for 7½ minutes, only 156 seedlings came up as against 1,048 in the control. Tests showed that there was no appreciable reduction in the germination power of the treated grain for a fortnight after immersion, so that it was evidently a case of delayed injury. Formaldehyde penetrates through the peripheral layers of the embryo either in aqueous solution or as a gas, and can destroy the cells of the coleorrhiza and even the entire embryo. In the former case the development of the radicle is prevented and the seedling is obliged to form adventitious roots. This explains the frequency of delayed germination after formaldehyde treatment. Phenol and codein were both found to be present in April, 1921, in the ungerminated seed sown the previous September. Formaldehyde

injury is stated to have been very general in the Rhine provinces during the period referred to.

At the Bonn Agricultural College tests were made of formaldehyde, fusafine, corbin, kurtakol, uspulun, phenolsulphonic acid mercury sulphate, 777, and 778 in 1919–20; and of chinosol, formaldehyde, fusafine, germisan, kurtakol, uspulun, and weizenfusariol in 1920–21.

Against bunt of wheat [*Tilletia tritici*] the best results were given in the spring wheat crop of 1920 by fusafine (0·25 per cent. for 30 minutes), the treated crop having only 0·04 per cent. bunted. Uspulun gave 0·12 per cent.; formaldehyde, 0·14; 778, 0·34; 777, 0·63; corbin, 0·69, and the rest over 1 per cent. Corbin and 777 caused the most severe seed injury. With winter wheat in 1920–21 germisan (0·25 per cent. for 1 hour) gave the best results, completely eliminating the disease. Formaldehyde, as already stated, caused very great seed injury. Weizenfusariol gave 0·34 per cent. bunt, uspulun 0·79, and both these preparations stimulated germination. On the spring wheat in 1921 uspulun and germisan, used in solutions of 0·25 per cent. for 1 hour, gave respectively 0·43 per cent. infection and complete control, the former being slightly the better in regard to the number of plants and ears in the plot. Germisan has been found to impede germination for the first ten to fifteen days, after which the plants quickly make up for lost time.

Against the fusariose of rye [presumably *Fusarium nivale* (*Calonectria graminicola*)] germisan, uspulun, and kurtakol were used in 1920–21. The first two completely eliminated the disease, and the seed showed good germination and subsequent growth, especially after uspulun. Kurtakol was ineffective.

Winter barley was treated in 1919–20 against stripe disease [*Helminthosporium gramineum*], when corbin and chinosol completely prevented the disease but seriously impaired germination, while uspulun reduced infection to a trace and at the same time had a stimulating action. In 1920–21 germisan gave complete control and uspulun 1 per cent. disease.

Against covered smut of barley [*Ustilago hordei*] and loose smut of oats [*Ustilago avenae*] the preparations that have given the most complete control so far are formaldehyde, copper sulphate, and weizenfusariol. The first two are, however, open to the objections mentioned above. Uspulun has not been very satisfactory, probably because it does not penetrate between the glumes sufficiently to reach all the spores.

Summarizing the results of the tests in 1920–21 the author states that formaldehyde is very effective against bunt and considerably reduces the stripe disease of barley; it is not so effective against *Fusarium*. Its general value is much lessened by its injurious secondary action on the grain. The same criticism is applicable to copper sulphate and chinosol. The colloidal copper preparation, kurtakol, is effective against bunt but is worthless for checking stripe disease or fusariose. Fusafine and weizenfusariol are also useful against bunt but worthless against stripe disease. Phenolsulphuric acid mercury sulphate has no value in the control of these three diseases. Corbin controls bunt and stripe disease but causes an excessive reduction in germination capacity. Uspulun effectively controls all

three diseases. Germisan, however, is, on the whole, the best of the preparations tested against these cereal diseases, its only defect being the retarding action on germination. A new modification of it, germisan T.B.S. 12, appears to have surmounted this difficulty.

The fungicidal action of germisan, uspulun, and KK10 was tested on spores of *Tilletia tritici* and *Ustilago hordei*. The strengths used ranged from 0·03 to 0·25 per cent. and the period of immersion from 5 to 30 minutes. It was found that uspulun requires a minimum concentration of 0·25 per cent. to kill the spores of *T. tritici* and of 0·12 per cent. for those of *U. hordei*. With germisan the 0·12 per cent. concentration suffices for both, so that in their germicidal effect on *U. hordei* there is little difference between the two. KK10, in which the CH_3 group of the benzene nucleus is replaced by an atom of chlorine, was found to be more powerful than the commercial germisan.

With regard to the influence of factors affecting the growth of the host on infection by *Tilletia tritici*, the author points out that the temperature during germination, the supply of plant nutrients in the soil, the physical condition of the latter, and the physiological activity of the seed after planting, all have to be considered. His observations support the work of earlier investigators who found late autumn and early spring sowings tend to increase bunt, since the temperature approaches the minimum for the germination of wheat and the susceptible period is prolonged. But the correlation between the rate of germination and susceptibility to smut requires further investigation. Good soil moisture, the use of nitrogenous fertilizers, and a loose texture of the soil favour rapid germination and are stated to reduce liability to these diseases.

In some experiments on the influence of nutrition on susceptibility to disease the author found that heavy nitrogenous manuring predisposed to the attack of *Erysiphe graminis*, but that *Colletotrichum lindemuthianum* did not seem to be in any way influenced by the nutrition of the host. His field observations do not support the statement frequently made that excessive nitrogen predisposes to the attack of *Puccinia glumarum*, except in so far that it prolongs the period of vegetative growth during which the plant is susceptible to injury by rust.

BREDEMANN (G.). **Versuche über Erhöhung der Keimkraft unserer Hanfsaat durch Beizung.** [Experiments in the increase of the germinating power of Hemp seed by steeping.]—*Faserforschung*, ii, 1, pp. 58-63, 1922.

In 1920 the investigations of the German Hemp Cultivation Society showed that scarcely half of the home-grown and imported Italian seed of hemp [*Cannabis sativa*] examined possessed the prescribed germinating power of 90 and 70 per cent. respectively. Experiments were accordingly undertaken in 1920 and 1921 to test the value of uspulun as a stimulus to germination. In the first series of tests (1920) the effect of steeping in uspulun (0·25 per cent. for one hour) was remarkable, the average result of five outdoor experiments with Italian seed being that for each 1,000 plants from untreated seed there were 2,254 from the seed treated with uspulun. In ten experiments with German (Russian) seed the lots treated

with uspulun gave 1,086 plants for each 1,000 from the untreated controls.

In 1921 the experiments were continued at the Agricultural Research Station of Landsberg-an-der-Warthe on a more extensive scale with Italian, Chile, and German (Russian) seed. It was shown that treatment with uspulun (same strength as before) increased the germinating power of the seed by 25 per cent., while immersion in water alone reduced it by 7 per cent. Thus with a seed rate allowing for an average stand of 80 plants per square metre on normal germination, steeping in uspulun produces 200,000 stems more per hect. It has not yet been ascertained whether the action is due solely to the known stimulating effect of uspulun, or if its fungicidal properties are also involved. In any case it can be highly recommended to hemp growers as a practical and reliable means of increasing the yield from poorly germinating seed.

SMALL (W.). **On the occurrence of a species of Fusarium in Uganda.**—*Kew Bull. Misc. Inform.*, 9, pp. 269–291, 13 figs., 1922.

The species of *Fusarium* previously described by the author from Uganda [*Kew Bull.*, p. 321, 1920] as causing a wilt of carnations, *Delphinium*, *Nigella*, and *Cosmos*, has since been found attacking other plants, among which are included *Antirrhinum*, seedlings of the cashew-nut (*Anacardium occidentale*), *Grevillea robusta*, *Eugenia jambos*, and the loquat (*Eriobotrya japonica*). On carnations and *Antirrhinum* it is sometimes associated with *Heterodera radicicola* and the author believes the latter is the primary parasite in the case of the *Antirrhinum*, the *Fusarium* having on this host a degree of parasitism so feeble that it was only just removed from saprophytism.

The attack on the cashew-nut seedlings takes the form of a severe wilt which is fully described and which, in some cases, was observed to kill up to 100 per cent. of the seedlings. Of the other hosts named *Grevillea* is next in order of susceptibility, while *Eugenia* and the loquat are but little damaged.

A full description is given of the cultural characters of the fungus on various media, as well as of a large series of cross-inoculations on the different hosts. From its morphological characters and the fact that he succeeded by inoculation with his organism in inducing a wilt of the pigeon pea (*Cajanus indicus*) similar to that described by Butler in India, the author provisionally identifies the Uganda fungus with *Fusarium udum* Butl.

SNOW (LAETITIA M.). **A new host for the fire blight organism, Bacillus amylovorus.**—*Phytopath.*, xii, 11, pp. 517–524, 1922.

In this paper the author first gives an exhaustive account of all records from 1793 onwards of the host plants affected by fireblight. Up to the present the organism has been shown to be able to infect the following hosts: pear, apple, quince, service berry (*Amelanchier canadensis*), English hawthorn (*Crataegus oxyacantha*), evergreen thorn (*Crataegus pyracantha*), wild crab (*Pyrus coronaria*), cultivated crab, Cheney plum (*Prunus americana nigra*), apricot, prune, and strawberry. Burrill's statement that the Lombardy

poplar is attacked is questioned, and the reports for other hosts appear to rest upon observational evidence only.

In establishing the ornamental shrub *Prunus triloba* var. *plena* as a new host for *Bacillus amylovorus*, a number of isolations were made from plants growing at Wisconsin, and two of these were selected for comparison with an isolation from the crab apple and a laboratory stock culture. The morphology and culture reactions of all these strains agreed and are described in detail. They also agreed, in the main, with the reactions quoted by other investigators, but the following exceptions may be noted. In the nitrate reduction test no nitrogen was evolved and no nitrates formed, but a moderate amount of ammonia was produced. After prolonged cultivation the power to digest casein was lost and the organism gave corresponding slight or no liquefaction of gelatine. No indol was formed.

All the strains developed a peculiar odour, which has been variously described and is difficult to characterize. Both strains isolated from the new host were pathogenic on the pear at first but lost their virulence after cultivation. The laboratory strain was non-pathogenic, whilst that from the crab remained strongly virulent after two years.

A bibliography of 34 titles is appended.

HERBERT (D. A.). **Bitter pit of Apples. The crushed cell theory.**—*Phytopath.*, xii, 10, pp. 489-491, 1922.

McAlpine's bursting cell theory of bitter pit in apples is not altogether supported by the writer's investigations.

It is generally admitted that the fluctuation in water supply is the primary cause of bitter pit, the point in question being in what manner the diseased patches are produced. The rush of sap to the apple after a fall of rain following a dry spell causes a distension of the parenchymatous pulp cells. If the cells in any particular pit area were to swell to bursting-point, wart-like bodies would be expected at affected points instead of depressions. In Dunn's Seedling the flow of sap after a rain is sometimes sufficient to burst the skin, but no bursting of the cells takes place within the apple. It is difficult to see how such bursting could occur in bitter pit, as the expansion of adjacent cells would bring the tissue into a state of static equilibrium and the only relief for the increased pressure would be a bursting of the skin or a crushing of some of the cells. Further an osmotic pressure of 100 atmospheres entirely borne by the cell may induce bursting, but this is immensely beyond anything occurring in the cells of the apple.

The vascular tissue may frequently be traced through a pit and found to be supplying healthy tissues beyond, which would not be the case if the vascular network were ruptured.

Pitting generally occurs at the time when the starch is undergoing conversion into sugar, and the theory is advanced that the affected cells have been killed by being crushed by neighbouring cells having higher osmotic pressure due to their higher proportion of sugar. With the sudden rush of sap to the apple, the cells which have already had their starch-contents converted into sugar will swell more extensively and rapidly than those still furnished

with starch. On the outside the rapid distension of the cells is resisted by the skin. Their force of expansion results in the crushing of those cells of which the starch transformation is backward. This explains the presence of quantities of starch in the dead pit cells.

The immunity from bitter pit of such varieties as Yates may be due to the uniform transformation of the starch to sugar throughout the tissue. In such cases there would be no small clusters of cells far enough behind in their starch transformation to be crushed by neighbouring cells of a higher osmotic pressure.

CUNNINGHAM (G. H.). **Brown rot, Sclerotinia cinerea Schroet. Its appearance, cause, and control.**—*New Zealand Journ. of Agric.*, xxiv, 8, pp. 83–98, 8 figs., 1922.

Brown rot is common throughout New Zealand except in Central Otago, where it is apparently unknown. Since 1915 the disease has been most destructive, and is now the most serious of all fungous diseases on stone fruits, occasionally attacking also apples and pears.

In New Zealand the causal organism of brown rot is *Sclerotinia cinerea* Schroet., the related fungus *S. fructigena* not having been found as yet. Apothecia from mummied fruits are produced only during the blossoming period and when they are not covered by more than an inch of soil. The disease usually appears first on the blossoms, infection occurring before the petals unfold or shortly after they have opened, and the period of infection extends from the beginning of September to the end of October. A wet season following a cold winter is usually accompanied by blossom infection. As a rule only a small percentage of blossoms is attacked, though in exceptional cases all have been killed. Blossom infection may be directly followed by infection of the developing fruits, but usually the latter only takes place at the time of maturity of the fruits. The formation of cankers and the dying back of the shoots are described.

On the leaves the fungus produces small, brown, more or less circular, dead areas, which may later fall away, leaving perforations similar to those caused by shot-hole fungi. In extreme cases the leaves are killed and fall prematurely, and the following season's crop may be reduced by this cause.

The successful control of brown rot is only possible when rigid orchard hygiene is practised. In addition the following sprayings are recommended: (1) when the buds begin to swell, Bordeaux 5–4–50 or lime-sulphur 1–15 [also useful in the control of leaf-curl (*Exoascus deformans*)]; (2) in early pinking, lime-sulphur 1–50; (3) petal-fall, lime-sulphur 1–120; (4) one month later, lime-sulphur 1–120; (5) when fruits are half-grown, lime-sulphur 1–120; (6) immediately before maturity, lime-sulphur 1–120. The sterilization of fruit cases may be effected by immersing them for one minute either in boiling water, copper sulphate solution 1–100, lime-sulphur solution 1–50, or formalin solution 1–40. Tins may also be immersed in any of the above solutions, except copper sulphate.

WINKLER (H.). **Behandlung stark befallener älterer Pfirsichspaliere.** [Treatment of severely infected old espalier Peaches.] —*Deutsche Obstbauzeit.*, lxviii, 41, p. 375, 1922.

A row of espalier peaches 100 m. in length at Bechau (Upper Silesia) was so severely attacked by leaf-curl [*Exoascus deformans*] and cochineal insects that the entire harvest was destroyed and many branches had to be removed. An examination of the soil, which was exceedingly hard and deficient in lime, indicated that malnutrition was a predisposing factor in the severity of the attack.

After removing all diseased material and thoroughly scraping the trees with wire and other brushes, the trunks and main branches were sprayed with a mixture consisting of loam, cattle-manure, and lime in water, to which was added 2 per cent. of fruit tree carbolineum. Early in March another application of carbolineum was given (200 gm. to 10 l. of water) to destroy any remaining spores. During the winter the soil was cultivated to a depth of 1 m., care being taken not to injure the roots, and fertilized with horn splinters, basic slag, 45 per cent. potassium salt, and a quantity of lime.

The trees were then sprayed with colloidal liquid sulphur (5 gm. to 10 l. water), the first application coinciding with the swelling of the buds and the second being given immediately before flowering. From the setting of the fruit till about three weeks before ripening applications were given every fortnight, always in the evening and in dull weather. The total consumption of sulphur amounted to 100 to 125 gm.

The trees were completely cured, the shoots being vigorous and the yield on the whole excellent. Peaches under glass were treated in the same way and gave even better results.

CIFERRI (R.). **Una rara malattia delle foglie del Susino.** [A rare disease of the leaves of the Plum.]—*Riv. Pat. Veg.*, xii, 5–6, pp. 59–64, 1922.

At Macerata in Italy the under side of some leaves of a plum tree (variety 'Luther Burbank') were found to bear small, punctiform, dirty white, waxy pustules, at first discrete, but later coalescing to a single, large, slightly raised mass surrounded by small, scattered pustules. Corresponding with these, on the upper surface, irregular, whitish areas occurred, the pale colour being due to the separation of the epidermis from the palisade parenchyma by a layer of mycelium.

The fungus was identified as *Microstroma tonelliauum* Ferraris, a species that differs from *M. platani* Eddelbeuttel & Engelke more biologically than morphologically. The conidiophores resemble basidia so closely as to justify the doubt whether the fungus should not be referred to the Basidiomycetes (Exobasidiales) rather than to the Mucedineae. Like other species of the genus, such as *M. album* (Desm.) Sacc. and *M. juglandis* (Bér.) Sacc., the present species diverges from the Mucedineae in the crust-like nature of the hymenium, which is covered with abundant spores adhering to one another, and also in the mycelial aggregations found especially beneath the epidermis as in many of the Exobasidiales. The

manner of invasion of the leaf, with the formation of fructifications on the opposite side to that attacked, is not common in the Mucedineae. Finally the author states that he has observed clamp-connexions such as are present in the Basidiomycetes. The fungus is considered to have affinities with *Aureobasidium vitis* var. *album* Montem., differing chiefly in the characters of the spores and in the fact that they are not borne laterally on the basidia. The absence of any hypertrophy of the leaf, so characteristic of attack by many species of *Exobasidium*, is noted.

In discussing the systematic position of the genus *Microstroma*, the author states that Patouillard first united in the genus *Exobasidium* both *Aureobasidium* and *Microstroma*, the latter as a subgenus. Later on, however, he considered *Microstroma* to be a lower form of the genus *Helostroma* of the Stilbaceae. Saccardo questions whether the latter is not the perfect Hymenomycetic form of *Microstroma*. Schroeter regards the genus as belonging to the Basidiomycetes, and this opinion is shared by Brefeld and Hennings. Briosi and Cavara refer *M. album* to the Mucedineae, with some doubt whether it may not be regarded as belonging to the Tuberculariaceae or Stilbaceae on the strength of the pseudostipitate type of conidiophore and the verticillate disposition of the conidia. *M. juglandis* is, however, referred by those authors to the Melanconiales because of its sporogenous stroma developed in the substomatal chamber. This species is placed in the Mucedineae by Lindau and Niessl, while the same view is taken in regard to *M. platani* by Saccardo, Eddelbeuttel, Engelke, Ferraris, and Tonelli.

As to the damage caused by *M. tonelliannm* the author thinks it unimportant and capable of control, if necessary, by spraying with Bordeaux mixture and by the destruction of affected leaves.

CIFERRI (R.). **Il marciume delle Mele Cotogne.** [Rot of Quinces.] —*Riv. Pat. Veg.*, xii, 1–2, pp. 12–17, 1922.

This rot, which is due to *Penicillium crustaceum* (L.) Fries (= *P. glaucum* Link), occurs on stored quinces in several regions of Italy, when conditions of moisture are favourable. It is a facultative parasite and is known to cause the rotting of a number of fruits, though the author thinks that it has not been previously reported on quinces. On these it behaves strictly as a wound parasite, being able to infect sound fruit through any cut or abrasion of the skin, however slight, provided the moisture conditions are suitable.

In relatively high summer temperatures the green mould on the surface of infected fruits bore here and there small, black, roundish, raised, isolated bodies, having a diameter of 200 to 300 μ, which were at first taken for the sclerotial form of this fungus described by Brefeld. These were found, however, to be merely dense aggregations, dark green in colour, and composed chiefly of conidia 3 to 3·5 μ in diameter. Similar conidial aggregations are sometimes found in cultures of various species of *Penicillium*. The author also observed, but more rarely, the form which, described by Cesati under the name of *Sporisorium maydis*, was referred by Saccardo to the genus *Chromosporium* as *C. maydis*. This is nothing more than the same *Penicillium* with the conidia more or less variously

arranged on the mycelium, without specialized conidiophores. The pseudosclerotia just mentioned are only an extreme development of this form. Another form, rather frequent on old rotted fruits, produces a pseudosynnema of the Stilbaceous type, ½ mm. broad by about 1 mm. high, bearing at the top a green head consisting of a mass of conidia. This structure is formed by numerous, slightly or not branched, rather densely fasciculated conidiophores, which vary in length but usually are very long, and average about 3 μ in diameter, and which are almost always sterile except at the free end, where there is a copious production of conidia.

As preventive measures the author recommends the rejection of all fruit showing the slightest lesion, the provision of dry storage rooms, and care in not placing the fruits in contact with one another.

Lynch (W. D.), McDonnell (C. C.), Haywood (J. K.), Quaintance (A. L.), & Waite (M. B.). **Poisonous metals on sprayed fruits and vegetables.**—*U.S. Dept. Agric. Bull.* 1027, 66 pp., 1922.

In 1915 a comparative study was undertaken by the United States Department of Agriculture to ascertain the amounts of arsenic, lead, and copper remaining on fruits and vegetables treated with poisonous sprays. The spraying was done under the direction of the Bureaus of Entomology and Plant Industry, and the chemical work by the Bureau of Chemistry. Various fruit trees and vegetables, including peaches, plums, cherries, cranberries, grapes, apples, pears, tomatoes, celery, and cucumbers, were sprayed according to accepted schedules, and also with excessive amounts of material, to determine how much of the metals may be present under adverse conditions.

It was found that overspraying or late spraying sometimes resulted in comparatively large quantities of spray residues; nearly all such residues, however, were removable by peeling. When the spraying was carried out in accordance with the recommended schedules, the quantity of metal adhering to the fruit or vegetables at harvest time was negligible.

The work of previous investigators is discussed at considerable length in the earlier part of the bulletin, which contains many references to the history of fungicidal and insecticidal sprays. A bibliography of 134 titles is appended.

Horton (E.) & Salmon (E. S.). **The fungicidal properties of certain spray-fluids. III.**—*Journ. Agric. Science*, xii, 3, pp. 269–279, 1922.

As a preliminary to a study of the exact fungicidal value of a mixture of lime-sulphur and arsenate of lead, the writers carried out in 1921 two series of spraying experiments: (*a*) with solutions containing arsenic acid, (*b*) with lime-sulphur and its constituents. The fungus experimented on was *Sphaerotheca humuli*, and the stage selected for spraying was the powdery, conidial stage found on young leaves from the 3rd to the 9th node of rooted cuttings of hops (*Humulus lupulus*) grown in an unheated greenhouse. The results of the arsenate tests showed that, under the conditions of the experiments, disodium arsenate containing 0·096 per cent. As_2O_5 was fungicidal, and also killed the leaf-cells underlying the

of Frankfort. The varieties selected for the test were Prof. Maercker and Daber. The results obtained were not satisfactory, the yield from the rows treated with trypaflavin not being equal to that from the untreated controls. The yield from tubers steeped in diaminoacridine sulphate and diaminoacridine nitrate, other preparations received from the same firm, exceeded that obtained from the rows treated with trypaflavin, but was still not equal to the controls. Trypaflavin was not found to possess any decided fungicidal properties as judged by the amount of scab, &c., on the tubers from the treated seed.

Versuche mit Tillantin B, einem neuen Saatgutbeizmittel. [Experiments with Tillantin B, a new seed disinfectant.]—*Deutsche landw. Presse*, xlix, 97–98, pp. 600–601, 1922.

At the Laboratory of Plant Physiology attached to the dye-works at Höchst-am-Main, a new fungicide, known as 'tillantin B', has been produced for the control of bunt of wheat [*Tilletia tritici*], covered smut of barley [*Ustilago hordei*], and loose smut of oats [*U. avenae*]. The mixture is stated to contain a new copper compound and a very powerful arsenical substance, which, it is claimed, produces an increased activity of the copper and absolutely counteracts any possible injury to germination.

Laboratory experiments showed that bunt spores could be destroyed with 0·01 per cent. of tillantin in 10 minutes. In field tests carried out at Höchst the yield in one series was increased by the use of tillantin to the extent of 14 per cent. as compared with the controls and with seed disinfected with copper sulphate. In another series there was an increase in the yield of 60 per cent. over untreated seed and of 29 per cent. over seed treated with copper sulphate. In all these experiments the sprinkling method was adopted.

Another test carried out at the Giessen Agricultural Institute confirmed the results obtained by the manufacturers. The yield from seed immersed in tillantin exceeded that from the untreated controls by 23 and 32 per cent. respectively in two separate series of tests.

Muller (H. C.) & Molz (E.). **Neue Versuche zur Bekämpfung des Roggenstengelbrandes.** [New experiments in the control of flag smut of Rye.]—*Deutsche landw. Presse*, xlix, 76, p. 491, 1922.

In the autumn of 1921 disinfection experiments were carried out with rye seed grain infested with flag smut (*Urocystis occulta*). The following preparations were used: rye fusariol, 23 gm. to 15 l. water, uspulun 0·33 per cent., germisan 0·25 per cent., and kalimat 0·25 per cent. The seed was sprinkled in every case. On 15th April, 1922, the results of the different treatments were compared. The growth in all the plots was very satisfactory. As regards disinfection, the best results were obtained with kalimat supplied by the firm of Ludwig, Meyer at Mainz, the average percentage of smutted plants being only 0·5. Uspulun and germisan reduced the infection to an average of 2 and 2·5 per cent. respectively. Slightly less satisfactory results were given by fusariol, the average percentage

of smutted plants being 5·5. In the untreated control plots the average of infection was 66·5 per cent.

JANSON (A.). **Bekämpfung des echten und falschen Meltaus.** [Control of powdery and downy mildew.]—*Deutsche Obstbauzeit.*, lxxviii, 23, pp. 224-225, 1922.

Owing to the scarcity of Sicilian dusting sulphur during the war the writer made use of the precipitated ground sulphur known in the trade as 'Prä'. The results were sufficiently favourable to justify further experiments on a larger scale, and these have been undertaken since 1919. Roses (wild and cultivated), currants, gooseberries, fruit trees, vines (outdoor and conservatory), cucumbers, beans, maize, kohlrabi, cabbages, and chrysanthemums have all been successfully treated. Even in large quantities, e.g. 100 kg. per hect., precipitated sulphur is absolutely harmless to the plants. The preparation is stated to be considerably cheaper and more economical in use than other sulphur mixtures, and has the additional advantage of being an excellent insecticide.

ERIKSSON (J.). **Betningsförsök med uspulun och supersolfo såsom kampmedel emot stinksot å vete.** [Steeping experiments with uspulun and supersulphur for the control of bunt of Wheat.]—*Kungl. Landbruks-Akad. Handl. och Tidskr.*, lxi, 7, pp. 607-610, 1 fig., 1922.

The author describes experiments made in the autumn of 1921 in the control of bunt of wheat (*Tilletia 'caries'*) by uspulun and supersulphur, the latter being a dark, thick, heavy liquid, consisting mainly of calcium polysulphides, manufactured from the by-products of illuminating gas by the San Paulo gasworks in Rome [see this *Review*, i, p. 67].

Pansar winter wheat heavily infected with bunt was used, the grain being immersed in uspulun solution at a strength of 2·5 gm., or supersulphur at 10 c.c., per litre of water. Each of the treated plots received 50 gm. seed and an equal amount untreated was sown in a third plot as a control.

In the early summer of 1922 the two treated plots were higher and more advanced than the control, the supersulphur plot being in flower by 22nd June; that treated with uspulun was somewhat less advanced and the control comparatively backward. The crop was harvested on 19th August when it was found that there was 83·8 per cent. of bunt in the control, 22·6 in the supersulphur, and only 0·5 in the uspulun plot. On the other hand, a much heavier yield was obtained from the plot treated with supersulphur than from that treated with uspulun.

It is suggested that higher concentrations of supersulphur might give a better bunt control and also that a combination of the two fungicides might unite the practically complete bunt control of uspulun with the apparently stimulating effect of supersulphur.

TRUESDELL (W. H.). **Plant pathology in Crimea.**—*Phytopath.*, xii, 11, pp. 533-535, 1922.

Plant disease control is quite backward in the Crimea; power sprayers are unknown and the sprays used are, when obtainable,

Bordeaux mixture and Paris green. Lime-sulphur is only known as a dormant insecticide, and self-boiled lime-sulphur as a spray against gooseberry mildew. The orchards are much neglected, no doubt because of the conditions resulting from a prolonged period of war and revolution.

Apple canker [*Nectria galligena*], apple scab (*Venturia inaequalis*), and pear scab [*V. pirina*] are serious. *Sclerotinia cinerea* and *S. fructigena* are prevalent, but only the latter is supposed to be responsible for injury to the woody parts of the trees, especially sweet cherries, advancing from the fruit to twigs and then to the main limbs and trunk. In the limestone country north of the Crimean mountains chlorosis is common in the orchards, but interesting results have been obtained by injecting into the trees a mixture of $FeSO_4$, K_2SO_4, and $MgSO_4$ through holes bored in the trunk, the foliage above the point of injection becoming green while that below remains yellow. *Gymnosporangium sabinae* is frequent on pears and *Sphaerotheca pannosa* was observed on peaches.

PEYRONEL (B.). **Sulla normale presenza di micorize nel grano e in altre piante coltivate e spontanee.** [On the normal presence of mycorrhiza in Wheat and other cultivated and wild plants.]—*Boll. mensile R. Staz. Pat. veg.*, iii, 4–6, pp. 43–50, 1922.

The author signalizes the invariable presence in a large number of wheat crops examined by him in various parts of Italy, of an endotrophic mycorrhiza agreeing in its main features with the mycorrhiza described by previous workers on many other plants. So far as he knows, the occurrence of an endophytic fungus-root association of this character has not previously been remarked on wheat, which, in common with the other cereals, oats, rye, and barley, is usually regarded as a purely autotrophic plant. In view of the variable nature of the fungus-root association as a general phenomenon he is, however, prepared to find that mycorrhiza may be absent under other conditions than those observed by him in Italy.

The fungus is characterized by its sparse development on the surface of the root, in contrast with the free growth that takes place in and between the cells of the cortex. In addition to the branched, haustorium-like 'arbuscules' present in many of the cells, large, acrogenous vesicles of varying shape are frequently formed and remind one of the zoosporangia of the Phycomycetes. In the epidermal cells and in the layer immediately under the epidermis, the hyphae are often characteristically bent in spiral or knee bends and may become divided by septa into short, barrel-shaped articulations which may even unite into small, pseudo-parenchymatous stromata. The mycelium is, however, usually hyaline or pale yellow and sparingly septate. On the extra-matrical mycelium the author observed the formation of large, barrel-shaped, moniliform conidia, in simple or branched chains, not separating into their component spores readily. Under suitable conditions, also, he obtained the formation of sporangium-like bodies in all respects analogous with the vesicles produced within

the roots, and the similarity of these organs to the zoosporangia of the Oomycetes is emphasized though zoospores were not observed.

While in some wheat plants considerable portions of the root system are invaded by the fungus, in others it is restricted to a few rootlets. Some differences in the morphology of the endophyte were observed in different localities, and it is suggested that these may depend both on the race of wheat cultivated and on the environmental conditions (soil, meteorological factors, and the like).

The same fungus was also found associated with the roots of oats, barley, rye, and maize, as well as in several weeds of cultivated fields, eight of which are named.

During the course of his examination of the roots of various plants for the presence of this endophyte, the author has frequently encountered a Chytridiaceous fungus allied to *Asterocystis radicis*, the well-known cause of 'brûlure' of flax in France and Belgium. On wheat and other plants (especially Cruciferae) this fungus is frequently present together with the endophyte already described, but always confined to the root hairs and epidermal cells. No injury seems to result from its presence, and the author is inclined to regard it as forming a special type of mycorrhiza though with parasitic potentialities.

In a foot-note added while the paper was in the press it is stated that the endophyte has been isolated and mycorrhiza successfully synthesized in pure culture.

FOËX (E.). **La dartrose de la Pomme de terre.** [Dartrose of the Potato.]—*Comptes Rendus Acad. Agric. France*, viii, 32, pp. 844–848, 1922.

During the period from July to September, 1922, the disease known in France as 'dartrose', due to the fungus *Vermicularia varians*, caused severe damage to the potato crops in the Departments of Charentes, Vendée, Vienne, Loire, Ain, Bas Rhin, Seine, Seine-et-Oise, Loiret, Saône-et-Loire, Rhône, and Lot-et-Garonne. The symptoms, as reported by Crépin [see this *Review*, ii, p. 27] and previous workers, are described. Ducomet and others have attributed its outbreaks to excessive drought and heat, but these factors were not sufficiently marked during the past summer to account for the epidemic.

The varieties attacked were an imported Dutch variety, Richter's Imperator, Wohltmann, Fin-de-Siècle, Merveille d'Amérique, Lesquin, Saucisse, Czarine, and Institut de Beauvais. The disease is stated to be more prevalent on early than on late maturing plants of the same variety. The same seed sown in two different localities has given in the one case a healthy and in the other a diseased crop. This does not preclude the possibility that infection is introduced with the tubers, as the influence of environment on the development of the disease is manifestly very great.

Dartrose not only reduces the yield of the crop but also impairs the quality. Control measures cannot be evolved until the source of the disease and its conditions of development have been studied in greater detail. Ducomet has shown that *V. varians* can pass from the seed tuber to the new shoots, and seed should therefore

not be procured from infected localities. All débris from infected crops should be burnt, while the efficacy of the methods of seed tuber disinfection employed against scab and *Rhizoctonia* deserve testing.

MAFFEI (L.). **La vaiolatura delle foglie dell' 'Arachis hypogaea' Linn. dovuta a Cercospora.** [The spotting of leaves of '*Arachis hypogaea*' Linn. due to *Cercospora*].—*Riv. Pat. Veg.*, xii, 1–2, pp. 7–11, 1922.

In this paper a leaf-spot disease of groundnut (*Arachis hypogaea*), observed in the Bereguardo district in 1921, is described. The leaves showed from 5 to 40, roundish or oval, dark chestnut brown spots of uniform colour, without a lighter centre or concentric markings. The spots bore, on both surfaces of the leaf, small dots consisting of the fructifications of a fungus. These were composed of numerous conidiophores in bundles, the individual conidiophores being geniculate, continuous (rarely uniseptate), brown, with a lighter apex, and 40 to 47 by 4 to 5 μ. The spores were borne on slight projections and were clavate, yellowish green, tapering above, at first continuous then with 8 to 12 septa, and 50 to 110 by 4 to 7 μ.

The fungus is a *Cercospora* which is considered to differ from *C. personata* (B. & C.) Ellis and *C. arachidis* Henn. in the larger spots of characteristic appearance, in the amphigenous fructifications, and in the spore characters. It comes near the latter species, however, and the author names it *C. arachidis* var. *macrospora*, a Latin diagnosis of the new variety being given.

For the control of the disease the author recommends burning the aerial parts of affected plants.

DUCOMET (V.). **Variétés de Pommes de terre et galle verruqueuse.** [Potato varieties and wart disease.]—*Journ. Agric. Prat.*, lxxxvi, 45, pp. 393–395, 1922.

After a brief discussion of the work of the potato testing stations at Ormskirk (Lancashire), Freeland (Pennsylvania), and Rostock (Mecklenburg), the writer states that, in view of the increasing danger of the introduction of wart disease [*Synchytrium endobioticum*] into France, some twenty English varieties, reported to be immune, have been under observation at the Grignon [S.-et-O.] Experiment Station for periods ranging from one to two years. Several of these varieties have been simultaneously cultivated in other parts of France. While it is too early to make definite statements as to the intrinsic value and adaptability of the English varieties, a few preliminary observations may be of interest.

In the first rank, both as regards reported resistance and general vigour, must be placed the medium-late variety Great Scot, while Kerr's Pink, Abundance, Rhoderick Dhu, Arran Victory, and Bishop also possess excellent qualities. The last-named appears to be somewhat susceptible to leaf roll, but is likely to prove a commercial success. As regards resistance to late blight (*Phytophthora* [*infestans*]), the varieties have been classified at Grignon in the following descending order: Kerr's Pink, Rhoderick Dhu, Arran Victory, Great Scot, Abundance, and Bishop.

None of the imported varieties fulfils all the French requirements, either because they are not sufficiently early or productive, or are somewhat inferior in quality. Absolute immunity from wart disease, however, outweighs a number of defects, and moreover the latter can, in all probability, be remedied by judicious crossing.

SCHLUMBERGER (O.). **Pflanzenschutz und Kartoffelzüchtung.** [Plant protection and Potato breeding.]—*Fühlings landw. Zeit.*, lxxi, 9–10, pp. 183–191, 1922.

The author, believing that as the science of crop protection advances increasing attention will be given to preventive measures as opposed to the direct treatment of disease, discusses the means of preserving the health and vigour of selected varieties of potatoes as well as the methods made use of in potato breeding. New varieties should be tested not only as regards their behaviour on different types of soil but also in order to gauge their resistance to disease. The work of Quanjer, Murphy, and Cotton is regarded as establishing that leaf roll is an infectious disease capable of direct transmission as well as of being conveyed by insects, mosaic being similar in these respects. Tests for resistance to these diseases must be carried out by interplanting with already infected crops of varieties such as Industry and Eigenheimer, which are known to be particularly susceptible to mosaic. Trials for resistance to blight (*Phytophthora infestans*) should be carried out preferably in mild and damp localities by interplanting with susceptible early varieties.

Resistance to wart disease [*Synchytrium endobioticum*] is specially important, and as the disease persists in the soil and increases in virulence from year to year, all new varieties should be subjected to tests of several years' duration before being put on the market. The western provinces of Germany are principally affected by this disease, and the resistant, yellow-fleshed varieties are in great demand there.

Questions of soil constitution and manuring also require careful consideration. In Stutzer's examination of soils carrying crops affected with leaf roll, 0·75 per cent. of free alkali was found. Soil analyses made by the author in East Havelland showed that the pronounced exhaustion of the potatoes in that district was connected with an excess of humic acid. Hiltner and Lang have recently again pointed out that the capacity to utilize and benefit fully from artificial fertilizers is confined to good varieties, poor varieties being marked by their lack of response to fertilization.

The different means of maintaining the varieties in a healthy condition require further study. According to the most recent investigations their development depends not only on the constitution of the soil, but to an even greater extent on meteorological factors. The proper temperature for the winter storage of potatoes and the correct time for harvesting are two other important questions demanding fuller investigation. The harvesting of immature tubers has been recommended both in Germany and England under certain conditions, but this has also been opposed by many.

The breeding of resistant varieties of the potato is complicated by its heterozygotic constitution. Every grower is familiar with

the number of types that may arise from a single seed-berry, and the consequent difficulty of knowing what hereditary qualities are present in the parents used for crossing. Thus most of the so-called resistant varieties, at any rate in Germany, are accidental products, and in many cases their immunity has proved to be only temporary. It is, moreover, still quite uncertain whether the hereditary quality conferring resistance in the potato is absolute or merely relative. Certain varieties which are stated to be immune from particular diseases in England have proved more or less susceptible in Germany. Many attempts have been made to secure early varieties resistant to *Phytophthora infestans*, chiefly by the selection of resistant plants in infected crops, but these have generally been found to be late-maturing individuals and thus the object has been defeated.

The correlation between resistance to disease and other valuable characters in the potato is also very imperfectly understood, and it is uncertain how far breeding for resistance may be combined with breeding for productiveness. It is, in fact, generally believed that the factors of high yield and immunity are mutually exclusive. Another point of great scientific and practical importance is the unusual longevity of certain varieties, e. g. Cimbal's Wohltmann and its relatives. Possibly such varieties may represent, not pure lines, but a collection of different types, varying in their soil and climatic requirements and mutually supplementing one another under unfavourable conditions.

The various problems indicated in this paper have been deeply investigated in the case of cereals, and the same time and care must be spent on their solution in that of the potato.

FRANCHINI (G.). **Nouvelles recherches sur les trypanosomes des Euphorbes et leur culture.** [New researches on the trypanosomes of Euphorbiaceae and their culture.]—*Bull. Soc. Path. exot.*, XV, 5, pp. 299-303, 1 fig., 1922.

The protozoa found in the latex of *Euphorbia nereifolia*, *E. caerulescens*, *E. anticurum*, *E. laro*, and an undetermined species, have been further investigated. In the last-mentioned, bodies resembling the small rings of the malarial parasite were found, and also Leishmaniform bodies and small amoeba-like organisms. In *E. nereifolia* the trypanosomes varied in form and dimensions and amoeboid types sometimes occurred.

Cultures obtained in Nöller's medium revealed transitional stages between the amoebae and the trypanosomes. There is first a small, homogeneous body with amoeboid movements. Later this increases in volume, the protoplasm becomes more differentiated, nuclei can be seen, and the amoeboid movements are more ample. A membrane, which expands and contracts somewhat rapidly, appears round the whole or part of the body. Still later the U shapes appear, the two free extremities being sometimes united by a thin membrane. Both in the cultures and in the latex of the plants the trypanosomes were very variable in size, the larger ones being less frequent and less mobile. Other amoeboid types were also seen and encysted forms were sometimes present.

Similar observations were made on the latex of *Excoecaria emarginata*, the development of the trypanosome in the host plant

appearing to follow the same course as that described above from cultures. Circular and Leishmaniform shapes also occur in this host.

FRANCHINI (G.). **Sur une amibe des Figuiers de plein air de la région parisienne et sa culture.** [Notes on an amoeba of outdoor Fig trees in the environs of Paris, and its culture.]—*Bull. Soc. Path. exot.*, xiv, 5, pp. 287–292, 3 figs., 1922.

The amoebae previously mentioned [see this *Review*, i, p. 450] as occurring in the latex of outdoor fig trees (*Ficus carica*) near Paris varied considerably in size and shape. Some were rounded and 12 to 20 μ or even more in diameter, others oval, 22 by 12 or 18 by 13 μ; smaller forms also occurred. In addition to these, very elongated flagellates, 28 by 4·5 or 22 by 2 μ, with flagella 6 to 8 μ long, were present.

Cultures of the amoebae were successfully made on Nöller's medium, the red blood corpuscles of which were ingested by the amoebae in the same way as is done by the pathogenic species of the human intestine. The forms observed in the fig tree resemble in some respects those found in exotic Urticaceae and in Asclepiadaceae and Apocynaceae, in which transitional forms between the amoebae and the trypanosomes have been seen, and the author thinks that the flagellate forms mentioned above are a stage in the life-history of the amoeba. Flagellate stages are known to occur in *Vahlkampfia* and the Myxoamoebae.

FRANCHINI (G.). **Sur une amibe de la laitue (Lactuca sativa).** [An amoeba of Lettuce (*Lactuca sativa*)].—*Bull. Soc. Path. exot.*, xv, 9, pp. 784–787, 1 fig., 1922.

In July, 1922, the author examined near Bologna a large number of lettuces, one of which contained numerous amoebae in the thick and acid latex. The plant had a sickly appearance, which may, however, have been partly due to the excessive heat. The amoebae varied in shape and dimensions; the protoplasm was very fine, vacuoles were rare, and the ecto- and endoplasm were not differentiated.

Cultures were obtained on Nöller's medium, amoebae being discernible on the fourth day. The organisms moved freely and were very similar to those of the latex, though slightly smaller.

The new amoeba, to which the name *A. lactucae* is given, appears to belong to the group already described as occurring in various latex-bearing plants of the Apocynaceae and Urticaceae.

FRANCHINI (G.). **Essais d'inoculation de différents protozoaires dans le latex des Euphorbes.** [Attempts to inoculate various protozoa into the latex of Euphorbiaceae.]—*Bull. Soc. Path. exot.*, xv, 9, pp. 792–795, 2 figs., 1922.

In this paper the author describes attempts to infect various species of *Euphorbia* with protozoa of known origin from insects and man, carried out in Italy in the summer of 1922.

Vigorous plants of *E. sauliana*, *E. segetalis*, *E. pilulifera*, and *E. ipecacuanha* were inoculated with cultures of the kala-azar organism [*Leishmania donovani*] from India, and these and other species

with organisms from oriental sore [*L. tropica*] from Sicily. *E. geniculata*, *E. segetalis*, and *E. piluliferu* were inoculated with *Herpetomonas muscae domesticae*; and *E. geniculata* with spirochaetes and with flagellates of the *Cercomonas* and *Trichomonas* types of human origin. Finally, several species were inoculated with the flagellate from cabbage bugs (*Pentatoma*) recently described by the author [see this *Review*, i, p. 311].

All the inoculated plants with their controls were placed in a greenhouse well protected against insects, and the latex examined at intervals. One of the two plants of *E. geniculata* inoculated with *Herpetomonas muscae domesticae* showed clear signs of infection after a time, while two plants of *E. ipecacuanha* inoculated with the organism of kala-azar also became diseased, one more severely than the other. The infected plants turned yellow, the leaves fell, growth was arrested, and the shoots withered. The latex was pale, very fluid, and deficient in starch; fifteen to twenty days after inoculation it contained Leishmaniform organisms, round or oval, generally isolated, and sometimes in process of division. The other inoculations failed, except in the case of *E. segetalis* inoculated from oriental sore when very slight infection occurred.

SANDERSON (A. R.). **Brown bast.**—*Bull. Rubber Growers' Assoc.*, iv, 8, pp. 380–381, 1922.

The author points out that the time during which tapping has been in progress is an important factor in the increase of the number of cases of brown bast in *Hevea* rubber trees. This increase is much more marked from the first to the sixth year of tapping, i.e. on the virgin bark and first renewal, than later, irrespective of the particular system of tapping employed. Finely developed, well-grown trees appear to be more susceptible, especially up to the age of eight years, than poorer ones, and the evidence so far available indicates that the incidence of brown bast is in direct proportion to the severity and frequency of the tapping system, but that as time goes on cases occur in trees that have been lightly tapped from the start.

The following figures are of interest as showing the increase in the percentage of brown bast with advancing age. In one case, eleven year old trees showed 20 per cent. of disease and thirteen year old trees 36·45 per cent. Another field of trees over twelve years old was twice examined for brown bast with a six months' interval between. At the second inspection there was an increase of 0·6 per cent. of new cases, the total percentage of disease being 33·75. On another estate, where treatment for brown bast has been given for some years, the first census showed 12 to 24 per cent. of disease. A second census taken eight months later showed an average increase of 5 per cent. in the number of cases, while at a third inspection after a four months' interval there was a further increase of 1 per cent. The growth and bark renewal on the estate in question were very good. In another field of 200 acres the cases of brown bast in the third year of tapping numbered 1,592 as against 1,066 in the first year.

Generally speaking, the annual increase in the number of cases

of brown bast is at present relatively low, on account of the prevailing tendency to adopt a less drastic system of tapping.

The reduction in the yield of dry rubber in trees affected by brown bast is frequently disregarded, yet the loss may amount to 30 per cent. or more. In extreme cases no latex can be obtained within the usual limits as regards height of cut. The total annual loss in revenue may be very considerable and must increase yearly unless precautions are taken to check the spread of the disease.

MANEVAL (W. E.). **Germination of teliospores of rusts at Columbia, Missouri.**—*Phytopath.*, xii, 10, pp. 471–488, 1922.

During the last five years observations have been made at various dates between autumn and spring on the resting period required by teleutospores of different rusts occurring at Columbia, Missouri. The author reviews the literature concerning the effect of moisture, temperature, chemicals, and maturity upon germination, and then describes experiments in which he tested the germination of teleutospores, previously collected and usually kept at room temperature, by floating them in 10 to 15 c.c. of distilled water in a covered dish incubated at room temperature. The tests showed that *Phragmidium potentillae-canadensis*, *Puccinia asparagi*, *P. helianthi*, *P. menthae* var. *americana*, *P. ruelliae*, *P. andropogoni*, *P. peridermiospora*. *P. sorghi* [*P. maydis*], *P. sydowiana*, and *P. windsoriae*, all eu-type rusts, were capable of germination in or before December. As the season advances there is a marked increase in the percentage of spores that will germinate in a given time. For instance, teleutospores of *P. helianthi* required 103 days for a high percentage of germination in October, 11 days in December, 7 days in January, 5 days in February, and less than one day in April. Similar results were obtained with *P. menthae*, *P. peridermiospora*, and *P. windsoriae*.

The time required for germination to begin decreases with the approach of spring. Spores of *P. helianthi* tested on 10th October 1917 germinated slightly in 70 days, on 27th December 1921 in 6 days, on 27th February 1918 in 1 day, and in April 1917 and 1922 in 1 to 2 hours. *P. peridermiospora*, *P. windsoriae*, *P. menthae*, and *P. ruelliae* behaved similarly.

Germination is favoured by prolonged floating on water and by alternate wetting and drying, and after it has begun in a culture it will generally continue for a considerable time. Teleutospores of *P. helianthi* germinated feebly at 28° to 29° C. but the promycelia were abnormal and practically no sporidia were formed. Spores of *P. windsoriae*, *P. peridermiospora*, and *P. helianthi* would not germinate at 32° C. but gave positive results when removed to room temperature (about 20° C.). Spores of *P. helianthi* failed to germinate after floating on water at 38° C. for 48 hours, but withstood drying for five days at 38° C. and still germinated. Temperatures above the maximum delayed, but did not inhibit, germination.

As compared with germination in distilled water, the process was retarded in solutions with higher H-ion concentrations (P_H 4·6 and 5·4) in the cases of *P. asparagi*, *P. sorghi*, *P. ruelliae*, and *P. menthae*. On the other hand, *P. helianthi* germinated in solutions

with a wide range of H-ion concentration (P_H 3·85 to 8·4), the limits for good sporidia production, however, being narrower (P_H 4·6 to 6·5).

BLUMER (S.). **Beiträge zur Spezialisation der Erysiphe horridula Lév. auf Boraginaceen.** [Contribution to the specialization of *Erysiphe horridula* Lév. on the Boraginaceae.]—*Centralbl. für Bakt.* Ab. 2, lv, 21–24, pp. 480–506, 5 figs., 1922.

The mildew on the Boraginaceae, included by Salmon in the collective species *Erysiphe cichoracearum* DC., is regarded by the author, on morphological and biological grounds, as a distinct species, *E. horridula* Lév. Although its specialization is not sharply defined, several biological races can be distinguished, each of which has its primary and secondary hosts. The former show infection regularly at the expiration of the incubation period (six to eight days). Secondary hosts are not regularly infected, and several weeks may elapse before the first symptoms appear. Infection in the latter case appears to result from conditions either very suitable for the fungus or unfavourable to the host.

The following 'formae speciales' are distinguished: *symphyti, pulmonariae, cerinthes minoris, asperuginis, cynoglossi, echii-myosotidis.* and *anchusae. Cerinthe major* is a host for all of these that have been tested and is stated to serve probably as a 'bridging species' to enable the *Oidium* on *Symphytum* to pass to *Echium vulgare*, and from *Echium* and *Myosotis* to pass to *Cerinthe alpina*. Most of these forms have several secondary hosts belonging to different genera.

E. horridula therefore differs from the forms of *E. cichoracearum* on the Compositae in its less sharply marked specialization, the latter being usually confined to a single genus, often to a few species within the genus. It differs morphologically in the frequency of 3-spored asci and in the germination of the spores. Morphologically three varieties or races of the oidial stage of *E. horridula* can be distinguished. In race *a* the conidia average 30 to 35 μ in length; this race includes the f. sp. *symphyti, pulmonariae*, and *cerinthes minoris*. Race *b* has conidia 21 to 30 μ long and includes the f. sp. *asperuginis* and *cynoglossi*. Race *c* has conidia 25 to 28 μ in length and includes the f. sp. *echii-myosotidis* and a form of unknown affinities on *Lithospermum*. It appears evident that the same host may be attacked by more than one morphologically distinct race as well as by different biological formae speciales.

BLUMER (S.). **Die Formen der Erysiphe cichoracearum DC.** [The forms of *Erysiphe cichoracearum* DC.]—*Centralbl. für Bakt.* Ab. 2, lvii, 1–3, pp. 45–60, 3 figs., 1922.

In the present paper the author continues his observations on the specialization of various races within the collective species *Erysiphe cichoracearum* [see preceding abstract]. The results of his experiments, a description of which is given, showed that the mildews on the Compositae were somewhat highly specialized, all attempts to communicate the infection to other genera than that from which the material was taken being unsuccessful. The author, however, does not regard these results as conclusive, the

experiments not having been conducted on a sufficient number of plants of varying ages. Probably in many of the experiments only the primary hosts were attacked. There is some evidence that the resistance of plants to mildew decreases with age, the disease generally being most virulent in the late summer and autumn.

E. cichoracearum embraces a large number of biological races of very unequal virulence. The forms occurring on *Centaurea montana* and *C. scabiosa* are very probably confined to these hosts. Within the genus *Hieracium* are two biological forms, one of which is restricted to the sub-genus *Pilosella* and the other to the *Euhieracia*. The oidia on *Senecio vulgaris*, *Centaurea jacea*, *C. phrygia*, *C. carniolica*, and *Cirsium eriophorum* attack principally species of one section within a genus. The strains on *Arctium*, *Sonchus*, *Prenanthes*, *Eupatorium*, and *Cirsium oleraceum* attack all species within the respective genera with approximately equal virulence. Kobel has suggested [see this *Review*, i, p. 79] that in parasitic selection the chemical affinity of the proteins in the host plants may be of paramount importance. The larger the genus the greater is the probability of its chemical heterogeneity, which would be reflected in parasitic selection within the genus. In the present case the individual species of the large genera *Centaurea*, *Cirsium*, and *Senecio* react to the *Oidium* exactly in the same way as genera of the Boraginaceae [see preceding abstract]. The species of *Arctium*, however, react to the *Oidium* in the same way as the Cucurbitaceae, specialization within the genus or family being absent in both cases.

The average dimensions of the conidia of the various races of *E. cichoracearum* referred to above, taken together, were 24·40 to 35·39 by 12·55 to 20·53 μ. On *Serratula rhapontica* and occasionally on other hosts irregular as well as normal conidia were found, the former being very reminiscent of *Ovulariopsis* Pat. & Har. (*Phyllactinia*) or *Oidiopsis* Scalia [*Leveillula taurica* (Lév.) Arn.]. According to Arnaud (Les Astérinées, ii, 1921), these irregularities would indicate reversions to primitive types.

Several of the biological races are distinguished from the others by the size of the conidia (e.g. the form on *Arctium* has conidia 34 by 20 μ) and these differences, though slight, indicate potential morphological separation. The genera *Hieracium* and *Centaurea* are each susceptible to attack by two morphologically and biologically distinct types of *Oidium*. Neger's experiments (*Flora*, xc, 1902) suggest that two distinct biological races also occur on *Artemisia*, one on *A. absinthium* and the other on *A. vulgaris*, and the author's preliminary examination has revealed possible morphological differences between these two forms.

Lafferty (H. A.) & Pethybridge (G. H.). **On a Phytophthora parasitic on Apples which has both amphigynous and paragynous antheridia; and on allied species which show the same phenomenon.**—*Scient. Proc. Royal Dublin Soc.*, xvii, N.S., 4, pp. 29–43, 2 pls., 1922.

In the present paper the authors describe a rot occurring in apples in Ireland. Cultural and inoculation experiments proved the causal

organism to be *Phytophthora syringae* and not *P. cactorum*, the species that has usually been found to cause rot in apples and pears in other countries. Economically the disease does not appear to be important, and it would probably be easily controlled by the destruction of all infected fruits.

The decayed apples had dark brown skins, but they were more or less firm and elastic to the touch. No superficial wounds were found, nor could any external indications of fungous growth be seen, though some of the lenticels showed small white tufts of hyphae after the affected fruit had been kept under a bell-jar in the laboratory for a few days. This mycelium bore a few sporangia and in addition sexual organs, which were found in the basal portions of the tufts and were of two types, the majority of the antheridia being paragynous (i.e. lateral or near the base of the oogonium, but not surrounding, or penetrated by, the latter), while a few instances of amphigynous antheridia of the type first discovered in *P. erythroseptica* (i.e. surrounding the oogonial stalk) occurred. The flesh of the diseased apples was brown and permeated by a rather coarse, non-septate mycelium, the hyphae being both in and between the cells. The white aerial mycelium, which was present in the cavities of the core, bore neither sporangia nor sexual organs, but the latter were found embedded in the soft tissues above and below these cavities. Here again antheridia of the paragynous type predominated.

The occurrence of both types of antheridia on *P. syringae* was confirmed by means of pure cultures obtained from portions of single hyphae, from single sporangia, and from a single oospore. In all cases the fungus produced sexual organs having both amphi- and paragynous antheridia. Sporangia are not produced abundantly as a rule, but when formed are borne on long, sympodially branched hyphae. They are obpyriform when mature, with no apical papilla, and average 40 by 27 μ. Germination is by zoospores, or sometimes by a germ-tube which frequently bears secondary, tertiary, &c., sporangia after a short growth. The oogonia are borne on rather short, lateral hyphae, and are pear-shaped and about 28 μ in diameter on an average. The antheridia, when lateral, are small, irregular, terminal swellings on short stalks which may arise either from the oogonial stalk or a neighbouring hypha. Antheridia of the amphigynous type resemble those already described in *P. erythroseptica*. The oospores are usually hyaline, spherical, and average about 25 μ in diameter, with walls from 1·5 to 2 μ thick. The fungus was proved to be pathogenic to apples and pears, but had no effect on potato tubers.

Cultural studies of *P. cactorum* and *P. fagi* received from several sources were also carried out. The authors give reasons for regarding these two species as distinct both morphologically and in their parasitic capabilities. In both cases sexual organs with amphigynous antheridia were occasionally produced, though the predominant style was the paragynous. The occurrence of bodies termed 'sphaero-conidia', round, usually intercalary spores, 33 to 40 μ in diameter, and germinating by germ-tubes, is reported in both species.

With the removal of these three species from the genus *Nozema*,

founded by Pethybridge for the species of *Phytophthora* with paragynous antheridia, the species *nicotianae* remains the only one in which up to the present amphigynous antheridia have not been observed. As further study may reveal their presence in this species also, the authors propose to abandon the name *Nozema* and reunite all species in the one genus *Phytophthora*.

Based on the mode of development of their sexual organs, the 22 species contained in the genus may now be grouped as follows:

A. Species in which, so far as is known at present, the antheridia when present are always amphigynous:

1. *P. infestans* (Mont.) de Bary.
2. *P. phaseoli* Thaxt.
3. *P. colocasiae* Racib.
4. *P. arecae* (Colem.) Pethybr.
5. *P. erythroseptica* Pethybr.
6. *P. parasitica* Dastur.
7. *P. terrestris* Sherb.
8. *P. allii* Saw.
9. *P. melongenae* Saw.
10. *P. meadii* McRae.
11. *P. cryptogea* Pethybr. & Laff.

B. Species in which the antheridia are preponderatingly paragynous, but are sometimes amphigynous:

12. *P. cactorum* (L. & C.) Schroet.
13. *P. fagi* Hartig.
14. *P. syringae* Klebahn.

C. Species in which, so far as is known at present, the antheridia are always paragynous:

15. *P. nicotianae* de Haan.

D. Species in which the mode of development of the sexual organs is not fully known, or in which these organs have not yet been found:—

16. *P. thalictri* Wilson & Davis.
17. *P. agaves* Vill. (?).
18. *P. faberi* Maubl. [But see following abstract.]
19. *P. theobromae* Colem.
20. *P. jatrophae* Jens.
21. *P. fici* Rau.
22. *P. citri* Rau.

[A 23rd species, *P. palmivora* Butl., overlooked by the authors, should be added to this group.]

Of these, *P. thalictri* is probably closely allied to *P. phaseoli*, and may ultimately be found to belong to group A. *P. agaves* and *P. jatrophae* have apparently so far not been described, and the latter (which has been issued in culture form) may be identical with *P. nicotianae*. On *P. fici* and *P. citri*, which were provisionally named in 1915, nothing further has been published. *P. faberi* and *P. theobromae* are probably synonymous. The latter is said to be closely allied to *P. arecae*, which would place it in group A, but antheridia are either absent or rare, and it is not known whether they are amphi- or paragynous. [The discovery of oospores with amphigynous antheridia in *P. faberi* is now reported. See next abstract.]

ASHBY (S. F.). **Oospores in cultures of Phytophthora faberi.**— *Kew Bull. Misc. Inform.*, 9, pp. 257–262, 1922.

Phytophthora faberi Maubl., the cause of pod rot, patch canker, and chupon wilt of cacao in the West Indies and most other areas where *Theobroma* is cultivated, has so far never been observed to

form oospores either in nature or in pure cultures: the bodies seen by Coleman and Rorer, and believed by them to be oospores, were devoid of antheridia and are considered by the author to be probably nothing but chlamydospores. The behaviour of the fungus, however, was found to be different when grown in mixed cultures with more or less related forms. Two of these were used. One was a species of *Phytophthora* that attacks the coco-nut palm in Jamaica (causing a serious bud rot) and has been identified as *P. palmivora*, while the other was a *Phytophthora* isolated in 1922 from rotting cotton bolls in St. Vincent. Neither of these two forms produces oospores in pure culture, and they appear to be identical in their vigour of growth, mycelial characters, and asexual reproduction. The cacao fungus differs from them in growing less vigorously and in developing sporangia less luxuriantly but, chlamydospores more freely, as well as in not forming characteristic mycelial aggregates that are usual in cultures of the coco-nut form. In all other respects, including the conidiophores and shape and size of the sporangia, *P. faberi* cannot be distinguished in pure culture from *P. palmivora* and the cotton boll fungus, but these last two have not been found capable of infecting cacao pods.

The first observations on pure cultures were made by the author at Kew during the summer of 1920. Pure and mixed cultures of the cacao and coco-nut bud rot fungi, isolated in Jamaica, were grown in tubes on slants of French bean agar in an incubator at 25° C. At the end of two months the pure cultures contained no oospores, while in the mixed cultures, obtained by inoculating the slants with the two organisms at a distance of about an inch from one another so that the independent colonies of each form met and mingled in a few days, oospores developed freely throughout the colony of the cacao fungus, and as far as the centre of the other growth. The mature sexual bodies were of the *P. infestans* type, with persistent amphigynous antheridia and a golden-yellow, thickened, oogonial wall. The mean size of the oospores was 23·3 μ with a variation from 19 to 26·5 μ.

With a view to controlling these results, pure and mixed cultures, technical details of which are briefly described, were grown in 1922 in Barbados with the cacao, the coco-nut bud rot, and the cotton boll forms. No oospores could be found in any of the pure cultures, nor were they present in the mixed cultures of two isolations of the coco-nut form or in mixtures of the latter with the cotton boll form, but in all the mixed cultures containing the cacao *Phytophthora* oospores were produced with the same characteristics as described above. A persistent antheridium, usually hyaline but occasionally yellow, was also present. The oogonia and antheridia always appeared to be developed on separate hyphae, but it was not possible to trace these hyphae definitely to the same mycelium. There was mutual penetration of the two colonies, but the more vigorous coco-nut and cotton boll strains appeared to push into the colony of the cacao fungus deeper than the latter did into their zones. The latter tendency was clearly shown in a number of mixed cultures in which a colony of the coco-nut form was allowed to develop for two days before the cacao fungus was inoculated on the upper part of the slant. In these examples oospores were

present up to the apex of the slant, and the mycelial aggregates of the coco-nut strain were present at the apex also, indicating that it had grown through the cacao colony.

The absence of oospores from pure cultures of the three *Phytophthoras*, their close relationship as indicated by the mycelial growth and the size and shape of the asexual spores, and the more vigorous growth of the coco-nut and cotton boll strains which appear to be identical, suggested that all may be strains of one heterothallic species, the two more vigorous strains being plus strains and the more weakly growing cacao form a minus strain. This view, however, is not supported by the fact that oospores of the same type and the same mean size and variation were also formed in mixed cultures of the cacao fungus with an unrelated species, namely, *P. parasitica*, isolated from *Ricinus communis* in India. The latter fungus is quite distinct from the other forms here mentioned both in producing oospores freely in culture and in its morphological and other characters.

The above observations show that the oospores formed in the mixed cultures are actually those of *P. faberi*; they are substantially larger than those of *P. parasitica*, but approach closely in size to those of *P. meadii* and *P. colocasiae*. The cotton boll *Phytophthora* is apparently identical with *P. palmivora*. The absence of oospores both in pure and mixed cultures of this species and some growth differences, as well as its inability to infect cacao pods, distinguish it from *P. faberi*, and the author regards it as no more justifiable to include it in one species with the latter than to unite it with *P. meadii*.

HOWARD (N. O.). **The control of sap-stain, mold, and incipient decay in green wood with special reference to vehicle stock.** —*U.S. Dept. of Agric. Bull.* 1037, 55 pp., 2 pl., 25 figs., 1922.

Green timber containing a high percentage of sapwood often suffers considerable damage during periods of transit and storage, especially during the late spring and summer months. Sap-stain may be divided into two classes, namely (1) the staining produced by chemical reactions due to the agency of certain oxidizing enzymes present in the wood itself; (2) fungous stains (blueing) caused by species of *Ceratostomella* and other fungi [see this *Review*, ii, pp. 49, 50]. The degree of susceptibility to sap-stain varies considerably in different species of timber. Among the conifers, southern and western yellow pine [*Pinus palustris* and *P. ponderosa*], sugar pine [*P. lambertiana*], and the spruces appear to be readily stained, while red gum [*Liquidambar styraciflua*], red oak [*Quercus rubra*], white oak [*Q. alba*], and hackberry [*Celtis*], among the broad-leaved trees, exhibit great susceptibility.

Superficial discoloration is caused by a number of moulds. Those recorded, either by previous investigators, or isolated during the work here reported, include 7 species of *Graphium*, 10 of *Penicillium*, 4 of *Aspergillus*, *Fusarium arthrosporioides*, *Alternaria tenuis*, *Stachybotrys alternans*, *Cephalothecium roseum*, *Chaetomium* sp., *Stemonitis* sp., *Gliocladium* sp., *Hormodendron* sp., *Hormiscium* sp., *Cladosporium* sp., *Citromyces* sp., *Clonostachys* sp., *Haplographium* sp., *Mucor* sp., *Oidium* sp., *Syncephalastrum* sp., and

Trichoderma sp. Neither the blue-stain nor the mould fungi, however, cause any appreciable dissolution of the wood fibres, so that the strength and durability of the timber are not materially affected.

The methods used in felling and handling the timber in the woods and the subsequent handling during transit and storage are briefly considered in relation to their influence on the development of moulds. Kiln drying is stated to eliminate or reduce decay, sap-stain, and moulds. Steaming the green timber is sometimes practised, and experiments carried out at the Forest Products Laboratory at Madison, Wisconsin, showed that it was effective at atmospheric pressure, when applied for not less than three hours, in killing surface fungi, but that the steamed timber moulded freely subsequently, unless piled so as to secure an ample circulation of the air.

Experiments in the chemical treatment of green wood showed that creosote dipping of red oak spokes prevented sap-staining but not the occurrence of moulds. The creosote bath was nearly as effective at 80° to 90° F. as at 150° to 155° F. Mercuric chloride (1 per cent.) was probably the best antiseptic for the control of sap-stain and moulds. Somewhat less satisfactory results were obtained from the use of 5 per cent. borax solution, and from dry quicklime, while common salt was quite ineffectual.

A further series of experiments was undertaken to determine the comparative values of various antiseptics and preservatives used for dipping red oak blocks. Where possible the solutions were made up to contain 1 per cent. by weight of the anhydrous salt. The blocks were immersed for approximately 10 seconds in the solution, drained, and then thoroughly sprayed with suspensions of the spores in water. Fifteen of the moulds above mentioned were employed. It was found that the blocks dipped in sodium carbonate, sodium bicarbonate, sodium fluoride, sodium bifluoride, ammonium fluoride, magnesium silicofluoride, zinc silicofluoride, and bleaching powder became severely moulded on exposure to a temperature of 80° F. and a relative humidity of 85 to 100 per cent. for three to four weeks. Potassium alum, potassium chlorate, and copper sulphate seemed to incite the growth of most of the fungi used in the inoculation experiments, especially *Aspergillus niger*. Borax effectively controlled sap-stain and prevented all but a slight development of mould. The efficacy of the preservatives was not increased by the addition of hygroscopic substances such as sodium chloride, calcium chloride, and glycerine. Of the organic compounds and mixtures tested, creosote and kerosene gave the best results, followed by mykantin, which, however, stained the wood yellow.

It is evident from these and the other investigations described that the prevention of sap-stain, mould, and incipient decay in green material can be best effected by a combination of remedial measures, of which the following are especially important. Care in the selection of raw stock, which should be free from fungous infections; expedition in the movement of raw stock from the felling of the logs to the stage in manufacture when the wood becomes sufficiently dry to withstand the attacks of fungi; provision for ample ventilation of the stock, thus ensuring at least surface drying; the kiln drying of the stock whenever possible; and in special cases steam

treatment or the use of antiseptic dips, followed by proper piling [full directions for which are given] to ensure adequate ventilation.

SCHMITZ (H.). **Note concerning the decay of western Yellow Pine slash caused by Polyporus volvatus Peck.**—*Phytopath.*, xii, pp. 494–496, 1 fig., 1922.

This note reports briefly the frequent occurrence of *Polyporus volvatus*, especially on western yellow pine [*Pinus ponderosa*] slash, in the north-west of the United States. The fungus has not been proved to be a parasite, though the possibility has been previously suggested, and the observations recorded by the author indicate that it has at least weakly parasitic tendencies.

STEVENS (F. L.). **A fungus destructive to asphalt shingles.**—*Phytopath.*, xii, 10, p. 497, 1 fig., 1922.

A roof of asphalt shingles, the shingles consisting of felt paper (similar to that used under carpets), saturated with asphalt and backed on one side with slate, was destroyed by a Basidiomycetous fungus, the mycelium of which resembled *Merulius lacrymans*. Stock shingles in storage are reported to be sometimes similarly damaged. The hyphae were found to have penetrated the shingle, subsisting presumably on the felt paper.

GARD (M.). **Sur le dépérissement des jeunes noyers en 1922.** [On the dying-off of young walnut trees in 1922.]—*Comptes rendus Acad. des Sciences*, clxxv, 17, pp. 716–718, 1922.

During the spring and summer of 1922 a large number of young walnut trees in south-western and central France suffered from a disease the chief symptom of which was a severe die-back of twigs and branches, often reaching far down the trunk and in some cases even killing the whole tree. This condition was sometimes accompanied by various external lesions; the bark sometimes peeled off and rolled up, and wounds formed at the forks of the branches from which a blackish and foul-smelling liquid was exuded. The bark turned black either completely or, in the large branches and the trunk, partially, sometimes only on one side. Many of the cells of the cortex, phloem, and cambium were blackened, and the discoloration extended into the medullary rays of the wood, though in the larger limbs it was limited to the newly-formed layers. The vessels contained gum. No organism could be found regularly present in the affected tissues and a physiological explanation has been sought.

The author believes this disease to be the consequence of the early autumn frosts of 1921, when the trees were still in full vegetation. The fact that the less vigorously growing trees with less sap were spared though standing in the immediate vicinity of the severely affected, more robust, sappy individuals is considered to support this view. In many cases the injurious effects were not visible in the following spring, the trees giving out new, vigorous shoots which, however, died back during the summer. This sequence of events was due, in the author's opinion, to cell injuries which resulted in the slow production of toxic substances and their diffusion with the renewal of growth to the more distant parts of

the tree. The disease was apparently not confined to walnut trees, various other plants such as figs, grape vines, and *Laurus nobilis* showing more or less similar symptoms.

BLIN (H.). **La maladie dite 'de l'encre' des Châtaigniers.** [The so-called 'ink' disease of chestnuts.]—*La Nature*, 2534, pp. 282–284, 1922.

The so-called 'ink' disease of chestnuts constitutes a serious danger to French sylviculture, especially in the Departments of Ardèche, Corrèze, Corsica, Gers, Lot, and Lozère. It is estimated that the disease has already destroyed more than 30,000 hect. of chestnut plantations.

Trees suffering from this disease present certain well-marked symptoms. The upper branches wither first, then those lower down. The leaves lose their brilliant green and become glaucous; their development is arrested, and they fall in August. The fruit does not ripen and adheres to the husk even after its fall. The roots become soft, spongy, and brittle, and exhibit deep purple or almost black areas, from which flows an astringent liquid with a pronounced empyreumatic odour. The tannin contained in this liquid combines with the iron in the soil to form a substance resembling ink. The small roots are withered, and their cortex becomes loosened: they are invaded by dark-coloured hyphae which penetrate the cortex and reach the medullary rays. In cases where the disease is of long standing, black patches appear on the trunk and branches shortly before the death of the tree. These patches form cankers from which exudes a liquid similar to that observed on the roots. It turns black on exposure to the air and stains the base of the tree.

Chestnut trees attacked by ink disease may languish for several years or die in a few months. No soil is exempt from the disease, which is, however, much more virulent in moist, closely packed, and impermeable soils. Trees growing on the banks of streams and in plains or valleys are usually attacked before those on slopes or in the mountains. Grafted trees are more susceptible than non-grafted, and certain varieties, amongst which are Green, Early Black, Early Red, and Corrive are extremely liable to infection. Generally speaking, coppiced trees are resistant.

Mention is made of Mangin's investigations which have led him to the conclusion that the disease is caused by a fungus, *Mycelophagus castaneae*, which destroys the mycorrhiza as they appear and induces a progressive necrosis of the roots. The latter are thickened and entirely enveloped in a fungous growth which arrests the development of the mycorrhiza and deprives the tree of the benefits normally resulting from symbiosis.

Experiments in the treatment of the disease have shown that watering the holes, before planting, with a 20 per cent. solution of iron sulphate produces excellent results. The introduction of resistant varieties is, however, the most promising method of dealing with the situation; *Castanea dentata* and *C. mollissima*, originating in Japan and China respectively, have been imported for French plantations with satisfactory results. This practice, however, has now been discontinued, or very greatly restricted

[see this *Review*, i, p. 280], owing to the danger of introducing material infected by *Endothia parasitica*, the cause of a very serious chestnut disease, which is prevalent in China and Japan but is as yet unknown in Europe.

KAUFFMAN (C. H.) & KERBER (H. M.). **A study of the white heart-rot of Locust, caused by Trametes robiniophila.**—*Amer. Journ. of Bot.*, ix, 9, pp. 493–508, 3 figs., 1922.

The white heart rot of the black locust tree, *Robinia pseudo-acacia*, caused by the fungus *Trametes robiniophila*, is very common in Southern Michigan, though it does far less damage than the attacks of the locust borer or of *Fomes rimosus*. The prevalence of the disease cannot be gauged by the number of sporophores observed, since the fungus fruits sparsely and the sporophore is soon disintegrated by the effects of the weather and by insect parasites.

A detailed examination of a diseased tree, thirty-five years old, was carried out. It had borne a large sporophore the previous year and another was growing from a frost crack at the time of cutting, while there were several old scars on the trunk marking the positions of earlier fructifications. Borer attacks were numerous, and the internal condition of the wood indicated that the tree must soon have succumbed to storms, though it still bore green and vigorous leaves.

The fungus had entered through borer holes in the large upper branches and had started a rot which worked down to the trunk. The numerous borer channels contained mycelium. The apparently sound wood was sharply cut off from the rotten areas by a very fine brownish-black zone, one-fourth to one-half a millimetre in width. Inside this line was an area of slightly rotted wood, light fawn to brownish-white in colour, solid in texture, but softer and lighter in weight than the sound wood. This area of incipient decay could be cut easily without breaking. Nearer the point of origin of the rot was an area of completely decayed wood of the same colour as the last, but very dry and friable, so that it could not be cut without breaking. This area was marked in the last stages of decay by white streaks composed of delignified wood fibres.

The effects of the fungus on the elements of the wood are described in detail. In the black border zone the elements were infiltrated by a brownish substance, the cells of the medullary rays and wood parenchyma being most heavily impregnated. The wood fibres were the least affected elements in this zone. No hyphae were found, though the holes made previously by the hyphae passing from cell to cell were plentiful. The dark colour is believed to result from chemical changes in the dead cells, but the exact origin of the brown substance was not determined. In the area of incipient decay hyphae were again absent, though the perforations that had been caused by them were larger and more numerous than in the border zone, especially in the medullary rays and wood parenchyma. The cell contents of these last two tissues had entirely disappeared. All the other elements showed evidences of fungous attack, the wood fibres being still the least affected. The badly-

decayed area in the centre of the rotten core was so brittle as to be difficult of examination. The bore holes of the hyphae were of still larger size, and the cell walls were in places riddled by them. The tracheids and vessels were merely a broken mass of fragments, but the fibres and medullary ray cell walls retained some degree of cohesion. In the final stages nothing was left in a recognizable form but the wood fibres, which were eroded and colourless from delignification.

In the apparently sound wood, immediately outside the dark boundary line, living mycelium was found in abundance, composed of hyaline, branched, septate hyphae, 1 to 1·5 μ in diameter. The hyphae passed from cell to cell both through the pits and through the normal wall, and were most numerous in medullary rays and wood parenchyma. The mycelium was abundant up to 7 cm. from the black line and no doubt extended much further, so that there was practically no sound wood left in this tree in a radial direction from the rotten core, and in a vertical direction for at least 2 ft. from the uppermost limit of the visible rot.

Tests of the strength of the wood were made from the apparently sound portions. In crushing tests the wood was found to stand only one-half to three-quarters (according to distance from the rotted parts) of the standard pressure per square inch which this timber should bear. The importance of this 'advance rot' is now receiving recognition in the case of other timbers, research into the cause of the loss of life during the war from weak spots in aeroplane timber having been specially directed to this matter.

The authors state that in the majority of the heart rots of trees hyphae are rare in the rotted tissues except when they occur in isolated nests or pockets. In the present case they appeared to be entirely absent from the areas of visible rot, except in the borer channels. How they disappear is not known and requires further investigation.

SCOTT (C. E.). **Disease of Chestnut trees new to California.**—*Monthly Bull. Dept. Agric. California*, xi, 10. pp. 740-741, 1922.

Eight year old chestnut trees in Grass Valley, California, have recently been attacked by a species of *Fusicoccum* somewhat resembling *Endothia parasitica*, the cause of chestnut blight in the eastern United States. The first symptom of the disease is a wilting or drooping of the foliage caused by the girdling of the branch or trunk by the fungus. The latter probably gains admission to the bark only through wounds. As it progresses it kills the inner bark while the tissues surrounding the dead area continue to enlarge and become elevated, leading to the production of a canker. The main advance occurs longitudinally on the infected branch, but extension also proceeds round the latter, interfering with the passage of food and killing the parts beyond the canker. The latter is more or less depressed according to its age, and may extend for several feet along the limb.

The minute spores developed in old cankers may be disseminated by means of insects, birds, implements, &c., to wounds in the

bark, where the disease will be reproduced under favourable conditions.

Diseased branches should be removed and burnt, and small cankers can probably be eradicated by excising all the diseased bark. All pruning or cutting wounds should be well disinfected, preferably with the cyanide of mercury—bichloride of mercury mixture.

The growing of chestnuts in California is still in a more or less experimental stage, being intended to meet the deficiency caused by the destruction of this tree by *Endothia parasitica* in the eastern United States. Hence it is highly important to guard carefully against the introduction of diseases and pests and to attempt to eradicate or control the present outbreak.

CABALLERO (A.). **El Boixat, o enfermedad de los Ajos, en Bañolas.** ['Boixat', or disease of Garlic, at Bañolas.]—*Bol. R. Soc. Esp. de Hist. Nat.*, xxii, 4, pp. 210–212, 1922.

For the last twenty years a disease, known locally as 'Boixat', has caused considerable damage in garlic fields in the Bañolas (Gerona) district of north-eastern Spain. The intensity of its attack in bad years threatens ruin to an otherwise profitable and important industry, the loss in 1914 amounting to 300,000 pesetas or 30 per cent. of the total value of the crop.

Various causes have been put forward at different times to account for the trouble, one being bacterial infection associated with colonies of *Rhizoglyphus echinopus*, another being the attack of *Tylenchus devastatrix*, with *R. echinopus* and *Anthomia cepurum* as secondary pests. Like Fragoso, the author found *Peronospora schleideni* in association with *Macrosporium parasiticum* on specimens from the district referred to, but in all cases he also found numerous globose-depressed, very hard, greyish-black, dull, rugose bodies, up to 1 mm. in diameter, on the bulbs. The appearance suggested the attack of a fungus belonging to the Tuberculariaceae, but further examination showed that only sterile mycelium and sclerotia were present and the parasite was identified by the author as *Sclerotium cepivorum*. It is regarded as the most destructive of the garlic parasites in this district. *S. cepivorum* has been united by Voglino with his *Sphacelia allii*, and by Sorauer with *Botrytis cana*. Delacroix and Maublanc, however, obtained nothing but an abundant formation of sclerotia in all their cultures, and this has also been the author's experience.

To check the disease it is recommended to burn all diseased plants, to suspend cultivation in the most infected fields, and to steep seed bulbs likely to carry infection in a solution of formalin at a strength of 1 to 300.

The Plant Pests Control Ordinance, 1922. Seychelles, 21st September 1922.

This Ordinance gives the Governor in Executive Council powers to control the importation of all plants into the Seychelles and to order any treatment necessary on such plants as are permitted to be imported. The Head of the Agricultural Department is authorized to dispose of imported plants and their containers by destroying

them, or by other methods, subject to the approval of the Governor, if he thinks necessary. The Governor may declare the existence of a pest and may regulate, on the advice of the Head of the Agricultural Department, the treatment to be adopted against such a declared pest. In the same way the Governor may declare an area to be infected, and the transport of plants to and from areas thus declared to be infected can be prevented under similar regulations. The carrying out of the regulations is entrusted to inspectors. The Governor may prohibit the transport of any plant from Island to Island in the Colony. The owner or occupier of any land suspected to be infected may be called upon by the Head of the Agricultural Department—subject to appeal to the Governor in Executive Council—to carry out any treatment deemed necessary, failing which a penalty is imposed and the treatment will be carried out by the Head of the Agricultural Department at the owner's expense. Penalties for non-compliance with this Ordinance are specified, and the prosecutions are entrusted to the Agricultural Department. Former Ordinances and Government Notices dealing with similar matters are repealed.

Plant Pest and Disease Ordinance, 1921 (No. 38 of 1921): Regulations. Dar-es-Salaam, Tanganyika, 19th September 1922.

The salient features of the Tanganyika Plant Pest and Disease (Coco-nut) Regulations, 1922, are as follows. The owner, lessee, or person in charge of any dead coco-nut palm shall immediately cut it down, burn the crown and any decayed parts, and bury the rest of the stem. An inspector may, at his discretion, prescribe the cultural measures or treatment to be adopted in the case of infection by pest or disease, and is authorized to superintend the work of destruction, if necessary, and to fix a time-limit for the execution of the prescribed measures. All dead leaves from the crowns of coco-nuts must be removed and burnt. No palm may be mutilated except for the purposes of tapping for the extraction of 'tembo'. Inspectors are authorized to see that each coco-nut tree is surrounded by an area not less than 5 ft. in radius free from underbush, underwood, grass, and weeds, and that these are cut down twice a year on all coco-nut plantations. The use of coco-nut stems as fence posts, in bridge building, and in other construction work (except for the interior of buildings) is prohibited. By order published in the *Gazette*, the Governor may temporarily prohibit the practice of tapping for 'tembo' in any specified area.